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Nature

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 2, 1911.

ARISTOTLE AS BIOLOGIST.

The Works of Aristotle, Translated into English. De Generatione Animalium. By Prof. A. Platt. Price 7*s.* 6*d.* net. De Partibus Animalium. By Dr. W. Ogle. Price 5*s.* net. Vol. iv., Historia Animalium. By Prof. D'Arcy W. Thompson. Price 10*s.* 6*d.* net. (Oxford: Clarendon Press, 1910–11.)

THE biological treatises of Aristotle are one of the chief marvels of antiquity. Remarkable in themselves for the evidence they give of the extraordinary powers of observation and reasoning possessed by their industrious author, they become truly astonishing when considered as only a comparatively small part of the life-work of a philosopher who entered profoundly into every department of human knowledge. The view has sometimes been entertained that after all Aristotle in his physical treatises was a mere copyist, that these works are rather of the nature of a literary compilation from sources now mainly lost than a record of original research and observation. A moderately careful study of, say, the "History of Animals" is sufficient to show that this is an error. Aristotle had undoubtedly made himself acquainted with what we should now call the "literature of the subject," and when it seems necessary he quotes from earlier writers. But it is not his way to borrow their statements uncritically. If Herodotus or Ctesias makes what he considers to be a mistake, he does not hesitate to say so. Moreover, the "History" teems with what are beyond all reasonable doubt good first-hand observations derived from actual dissection.

That errors should be numerous is only what might be expected considering the necessary limitations to research in the fourth century B.C. But it must be allowed that in his zoological and physiological speculations Aristotle displays reasoning powers of the highest order, and indeed it is often difficult to see that with the only data open to him he could have come to any sounder conclusions. It is curious that in the case of the strange phenomenon of hectocotylisation in the dibranchiate cephalopoda the Greek fishermen were right and Aristotle was wrong. But even here, as Prof. Platt remarks, he seems justified on the evidence before him. He could see no connection of the hectocotylised arm with the vasa deferentia, and "it is no wonder that he thought this decisive against the theory of the fishermen. He only deserves credit for doing so."

But in spite of this and many other errors perhaps equally excusable, it is undeniable that the three treatises before us contain an immense amount of accurate observation and skilful reasoning. Speaking of the "De Generatione Animalium," Prof. Platt says with truth, "should any man of science come fresh to the reading of this treatise, he will, I think, be amazed and delighted to see what grasp and insight Aristotle displays in handling questions which still absorb us after all the time" that has since elapsed.

The question of the dates of the composition of these books is of considerable interest in its bearing on Aristotle's more strictly philosophical work. Prof. D'Arcy Thompson lays stress on the frequency of reference in the "History of Animals" and other Aristotelian writings to the island of Lesbos and places near it. From this and other evidence he inclines to the view that Aristotle's natural history studies were carried on, or mainly carried on, between his two periods of residence in Athens, for during this interval he is known to have lived for two years in Mitylene, before his summons to the Court of Philip to undertake the tutorship of Alexander. Mr. Warde Fowler, on the other hand, thinks it probable that the "History" was at any rate begun in early life, the foundations being no doubt laid during his boyhood at Stageirus.

"This little town," as Mr. Fowler points out, "is placed in a most favourable position for a naturalist. It lies on a sea abounding in fish; above it rise the wooded heights of the eastern coast of the Chalcidic peninsula on which it stands; only a few miles distant is the river Strymon, which was so famous for water- and marsh-loving birds, as to give its name as a perpetual epithet to at least one species ['Strymoniæ grues']. Straight across the sea from Egypt and the Soudan came, and still come, every spring, multitudinous armies of migrating birds; they rest awhile about these rivers of the Thracian coast,

and then pursue their way northwards, crossing the Balkan Mountains into the plains of the Danube and Russia, to return again in the autumn. And, of course, for an inquiring naturalist a seaport town is always a desirable place, for here come sailors from foreign lands with tales of strange birds and beasts and plants, specimens of which they sometimes bring home with them. . . . We may be sure that young Aristotle was quick to profit by these chances."

Whatever may have been the point in Aristotle's career at which the "History" was projected, there can be little doubt that he was always taking such opportunities as offered for making additions and corrections. It is also reasonable to suppose that the book as we have it may contain annotations by some of his pupils. The treatises "De Partibus" and "De Generatione" are shown by internal evidence to be later as a whole than the "History."

The present excellent translations will serve, it may be hoped, to induce many students of the history of biological knowledge to undertake an examination at first hand of the works of this great scientific pioneer. Aristotle suffers little by intelligent translation, for his excellence lies in the matter of his writings rather than in their form. "The author himself," as Prof. Platt justly observes, "would have been the last man in the world to complain of any sacrifice of graces of style." Though the translators have no doubt nearly always succeeded in "representing as exactly as possible what Aristotle said or meant to say," it must not be supposed that they have denied themselves the use of good and vigorous English. Dr. Ogle's translation of the "De Partibus" in especial (a revision of his former well-known version) is admirable as a piece of literary workmanship. The notes of all three translators are good and useful so far as they go; but to produce a completely annotated edition of Aristotle's biological works in the light of modern knowledge would be a task from which the boldest might shrink. The typography and general get-up of these volumes are all that could be desired, and are worthy of the reputation of the Clarendon Press. It should always be remembered with gratitude that their publication is due to the generous provisions of the will of the late Prof. Jowett. F. A. D.

SOUTH AFRICAN ORCHIDS.

Icones Orchidearum Austro-Africanarum Extra-Tropicarum; or, Figures, with Descriptions of Extra-Tropical South African Orchids. By Dr. Harry Bolus. Vol. ii., pp. vi+200+100 plates. (London: Wm. Wesley and Son, 1911.) Price 2*l.* 2*s.* net.

TO Dr. Bolus's many botanical friends this volume, his last contribution to South African orchidology, has a special interest. Its production was the ostensible motive of his frequent journeys home during the past few years, and the revision for the press of its last few pages was completed on the eve of his death, which occurred shortly after his arrival in England early in the summer of the present year. The copies of his book, distributed by his niece and co-worker, Miss H. M. L. Kensit, are a fitting memento of the author and of the important influence he exerted on the progress of botanical exploration in South Africa. Bolus's botanical work was not confined to the study of the orchids. His wide and critical knowledge of the heaths is embodied in his contribution on that family in the "Flora Capensis"; and his extensive herbarium, which now passes to the South African College, bears witness to his general knowledge of the flora. But he will probably be best known for his careful study of the orchids, the results of which are embodied in various papers, but especially in the volume on the "Orchids of the Cape Peninsula" and the two volumes of the "Orchids of South Africa," the second of which is the subject of this notice.

The plan of the book is uniform with that of vol. i., which appeared in two parts (1893 and 1896 respectively). Excepting a few double plates and one on which are figured two species of Mystacidium discovered by, and dedicated to, Miss Alice Pegler, of Kentani, each of the hundred plates is devoted to one species; and the text consists of a corresponding number of quite separate technical descriptions. A characteristic feature is the duplication of each description in Latin and English. The distribution of each species is indicated by a citation of localities with collectors' names and numbers, and an indication is given of the source or sources from which the actual specimens figured were derived. The great majority of the plates were drawn from living specimens by Dr. Bolus himself, and the noting on the plate of the exact date at which the drawing was made shows that the material for the volume had been accumulating for more than twenty years. The extended period of preparation accounts for a slight want of uniformity of treatment. A few of the plates are in black and white; in the greater number, however, colour is used in proportions varying from the tinting of a simple leaf or flower to the full-blown coloured plate, such as that of *Disa uniflora* (plate 63). All are alike admirably clear, and include, in addition to the habit illustration, careful detailed drawings of the parts of the flower.

The species figured and described represent nineteen genera, but a large proportion are included in the typically South African genera, Disa, Satyrium, and Eulophia. Some are well-known species; a good proportion were discovered and have been previously described by Dr. Bolus, while a few, such as *Eulophia Pillansii* and *Mystacidium Aliciae*, are described here for the first time. Some are of special interest as representing rediscovered species. For instance, *Disa Telipogonis*, Reichenb. f., a remarkable little plant found by Berg on the summit of Table Mountain in 1816, was rediscovered in the same locality by Miss Kensit in 1904. The only other record of its occurrence was from the mountains in the Wellington district, where Dr. Schlechter found it in 1896, at a somewhat lower elevation.

A pleasing feature of Dr. Bolus's work is the readiness with which he gives credit wherever possible to those who have helped in his work either by sending specimens, or with their critical knowledge. Among these helpers may be mentioned, besides Miss Kensit, Dr. Schlechter, whose knowledge of the Cape orchids was perhaps second only to that possessed by Dr. Bolus, and Miss Alice Pegler, who has done good work

in the botanical exploration of the Kentani district, and to whom are dedicated the two new species of Mystacidium figured—her own discoveries. To these and others Dr. Bolus gives grateful recognition in his introductory note.

An index comprising a list of species and synonyms is placed at the end of the text matter, and a good portrait of the author as a frontispiece is a pleasing addition. A. B. R.

THE STUDY OF FIELD CROPS.

Southern Field Crops (exclusive of Forage Plants). By Prof. J. F. Duggar. Pp xxvii+579. Rural Text-book Series; edited by L. H. Bailey. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 7s. 6d. net.

AT a certain stage in his studies the agricultural student is called upon to consider crop-growing in its economic aspects, and he soon finds himself in a wide and rather indefinite field, where, in theory, his chemistry, botany, entomology, &c., ought to meet, and where the bearing of all the sciences on practical agriculture ought to be made manifest. In theory the student is to be directed in his studies of this branch of the subject by a man whose attainments in these several sciences is beyond reproach, and who has also a first-hand acquaintance with the economic problems involved. But in practice this ideal combination is never attained, and consequently the study of field crops goes in with agriculture, and is left entirely to the empiricist, no man of science having set up any claim to deal with them from the economic point of view.

Like other teachers of agriculture, Mr. Duggar is an empiricist; but he is an enlightened one, and makes liberal use of the data accumulated by his *confrères* on the science side. He deals, as one would expect, very fully with maize and cotton, to each of which some ten chapters are devoted, the rest of the book being occupied with the less common crops—wheat, oats, sorghum, rice, &c. The usual arrangement of the subject-matter is to begin with the structure of the plant; then to pass on to its races and varieties, the methods of breeding or improvement, the soils and fertilisers best adapted, the appropriate tillage and cultivation, and finally the insect and fungoid pests. Thus the whole field of science is covered, from chemistry and botany to entomology.

Considering how much such a task is beyond the powers of any one man, Mr. Duggar has done remarkably well. The purist in method, of course, might object to the empirical treatment of the subject, and feel dissatisfied with the numerous bald statements, such as "Insect pests [of oats] are the same as those of wheat, except that the oat is not attacked by the Hessian fly," just as the purist in language (and many others as well) might object to another statement—"*ensilage* is the verb, as 'to ensilage corn,' with the accent on the middle syllable." But these difficulties are inherent in the subject, and it would be unreasonable to judge the book from a point of view other than that from which it was written and will probably be used.

For in the meantime, while he is waiting for the true scientific treatment of crop husbandry to be developed, the student needs some one book in which he can find collected all the information he wants about ordinary crops. He is more concerned with the facts themselves than with their bearing on one another or on any central hypothesis. From this point of view Mr. Duggar's book is very good; there has obviously been a great deal of work expended in collecting the facts, and the references to the literature at the end of each chapter, if not entirely satisfying to the man of science, will at any rate put the student in touch with other work on the subject. In the present state of our knowledge the collection of the facts relating to the growth of crops is extremely necessary for further progress, and Mr. Duggar has contributed material that will be found distinctly useful.

As in the other members of this series, the book is well illustrated, and the pictures are well chosen, there being remarkably few of the ordinary useless field views. "An honest book," Dr. Bailey calls it in his introduction; ". . . these makers of observation text-books, that present the crops and the animals in their real and living details, will set going a great quiet movement to examine minutely the conditions of agricultural failure and success." E. J. RUSSELL.

PROPERTIES OF MATTER.

General Physics for Students: a Text-book on the Fundamental Properties of Matter. By E. Edser. Pp. ix+632. (London: Macmillan and Co., Ltd., 1911.) Price 7s. 6d.

IT is not often that a text-book, published under a familar title, presents so many novel and valuable features as Mr. Edser's latest production, "General Physics for Students." It is scarcely too much to say that with regard to contents and general mode of treatment the book forms a class for itself. By the collection of so much fresh material into one volume, Mr. Edser has made accessible to students many parts of physics, which, either from lack of time or initiative, they have hitherto been unable to appreciate. This has been done in no meagre fashion, the details, both experimental and theoretical, being consistently of a very comprehensive character.

The very care which has obviously been bestowed upon the work in order to suit it to the needs of students has, we think, been the cause of the one unfortunate feature of the book. This is the avoidance of the use of calculus notation—a procedure which the author seeks to justify in the preface. There is undoubtedly much to be said for such omission in the case of junior students whose teaching involves but rare recourse to calculus methods; but to continue the practice through a book of this kind is open to grave objections. The students who use the book may be divided into two classes—those sufficiently acquainted with calculus notation and methods, and those ignorant of them. The former class are liable to become annoyed at the repeated integration from first principles of the same function; the latter class may become accustomed to regard the laborious processes given as essential parts of the problems in

question. The author's reasons for following this method are not apparent, but we are tempted to believe that it is in order to conform with the regulations of the University of London, which still insist that the pass degree in physics should be obtainable without a knowledge of the calculus.

The earlier chapters of the book are devoted to the principles of mechanics, special attention being paid to oscillatory and gyrostatic motion. The simpler parts of the subject seem somewhat curtailed, but that is, perhaps, excusable in view of the very comprehensive nature of the book. Following chapters on gravitation and elasticity, we find surface tension very fully treated, and it is noticeable that the author very properly points out the inaccuracy of the statement often made, that the surface tension is equal to the surface energy per unit area. Chapters xi. to xiv. introduce subjects the inclusion of which renders this book unique. The author deals in a simple yet detailed and exact manner with the motion of fluids, including applications to the properties of vortex filaments and the waves on the surfaces of liquids. In the concluding chapter there is also to be found much that is new from the student's point of view. The consideration of the kinetic theory of gases is more complete in many respects than that which has usually been given, particularly with respect to the influence of the finite size of the molecules and the various methods of estimating their size and number.

As in Mr. Edser's other books in this series, the printing is excellent, and the heavy type used in the more important statements is very desirable. Good figures and diagrams form another pleasing feature. A wealth of examples (to which answers are given) should enable the student to become thoroughly acquainted with the principles described, and there is little doubt that the book, both from its general excellence and unique features, and notwithstanding the calculus methods referred to, will become almost indispensable to the students of physics.

MARINE ENGINES.

Marine Engine Design, including the Design of Turning and Reversing Engines. By Prof. Edward M. Bragg. Pp. 172. (London: Constable and Co., Ltd., 1911.) Price 8*s.* net.

IN this small book the author has endeavoured to describe methods by which the

"detailed design of the principal parts of marine engines can be determined, and has concentrated the results of several years of experience in teaching the subject of marine engine design to students of the University of Michigan."

Within these modest limits the volume should prove useful as a class-book for students, although it cannot be admitted that Mr. Bragg is accurate in the opinion, expressed in his preface, that

"most of the text-books on the subject of marine engines deal only in a general way with the subject of design, and particularly . . . as referring to the numerous coordinating parts of the modern marine engine."

On the contrary, many excellent text-books exist—in English, French, and German—which contain full discussions of design of details for marine engines and numerous examples drawn from actual practice. The distinctive feature of the book under review is really found in its exclusive devotion to details of design, whereas preceding text-books have been more comprehensive in scope, and as a consequence are larger and more expensive.

Prof. Bragg confines attention to marine engines of reciprocating types; he leaves untouched problems connected with steam turbines as applied to ship-propulsion, although these are undoubtedly of primary importance in present circumstances. Rules and specimen calculations are given for determining the dimensions of cylinders, the "cut-off" in the admission of steam, the length of stroke, and other particulars for engines of specified powers and given rates of revolution. Steam speeds, valve diagrams, valves, and valve-gear are treated at considerable length. Attention is directed also to methods for calculating the strengths of many of the principal fixed and moving parts of reciprocating marine engines; in some cases the rules for details of marine engines issued by the principal societies established for the survey and classification of merchant shipping are reproduced.

The last two sections of the book contain a full discussion of the details of design for auxiliary engines fitted for the purpose of turning the crank-shafts over—when valves are being set or when the main engines are being overhauled—and of designs for small engines used for reversing the main engines in steamships. About one-sixth of the total space in the volume is devoted to these subjects, although they are unquestionably of less relative importance than must be assigned to other matters, to which less attention has been devoted by the author. His hope and expectation, as expressed in the preface, are that by keeping the book "free from the descriptive part of the subject it will fill a decided void" and be "much more readily available" than other text-books "for the particular use for which it is intended." The majority of students will, in all probability, favour the use of text-books which are less restricted in aim, and are richer in descriptions and illustrations of various types of engines. This opinion, however, in no sense reflects on the manner in which the author has done his work; and, of course, he is entitled to form and act upon his own estimate of the kind of text-book likely to prove of most service to students of marine engineering.

W. H. W.

OUR BOOK SHELF.

Puppets: a Work-a-Day Philosophy. By George Forbes, F.R.S. Pp. ix+183. (London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

THIS is a philosophical sketch, or skeleton, clothed upon with the human interest of a story. A party of happy and well-to-do people are staying at a Scottish castle, and James Gordon expounds to them his philosophical views. These are of the idealistic kind, which may roughly be called Berkeleyan, and Gordon develops them very ingeniously, making some use of the modern psychological doctrine of the subconscious. All our knowledge of the world is a mental knowledge; all "things" are *thoughts* or, at least, cannot

be proved to be anything further. But this does not destroy anything of importance, or reduce cosmos to chaos, as "common-sense" might suppose. The world of each one's experience is real enough in each one's own mind, and there is no gain in attributing to it any material kind of reality. The concordance, in a general way, of my experience with your experience, is explained by supposing a universal-thinking or dominant Self who is thinking the world. Or, as Berkeley would say, the universe exists as the thought of God.

Our human selves are greater than their present manifestations. For educative purposes, each of us has been given a puppet to work and manage (our bodies, namely), and we can only express ourselves very inadequately through this dull mechanism. Indeed, some of the faculties we are proud of are the results of our limitations—for instance, reasoning. "There is simply no limit to what the mind can think of were it not spoilt by reasoning." Witness the marvellously accurate movements of the fingers in piano-playing, movements which must be supposed to be controlled by intelligence, but which certainly could not be performed at that speed if the slow consciousness had to superintend every muscle-twitch. Similarly with calculating prodigies, who multiply six figures by six figures, not in the way we multiply, but by a sort of instinct.

This philosophy, of course, includes some kind of immortality, for, though the body-puppet dies, the self which worked it is not thereby rendered any less alive; and it goes on experiencing, in other forms, probably not spatial and temporal.

The psychology of the book is quite admirable, and even its farthest-reaching speculations (which are put forward as such, and not as dogmas) are logical and justifiable, from the idealist's point of view. And the philosophic pill is nicely sugared with two love stories which end as happily as the most benevolent reader could desire. J. A. H.

The Relative Volumes of the Atoms of Carbon, Hydrogen, and Oxygen, when in Combination. By Hawksworth Collins. Pp. 107. (London: Morton and Burt, Ltd., 1911.) Price 7s. 6d.

THE author's views on the volume relations of the atoms in chemical combination differ fundamentally from those of previous observers. The present book deals exclusively with liquids containing carbon, hydrogen, and oxygen. At 15° and atmospheric pressure an atom of hydrogen, when in combination with an atom of carbon, occupies one of four relative volumes, viz., 15·25, 12·22, 9·95, and 5·76. The volume of any one atom of hydrogen is determined by the portion of the carbon atom to which it is attached. There are four portions of the carbon atom, corresponding with the valencies, and the theory implies that the valencies are unequal. The relative volume of the carbon atom is generally 0·71, but in certain circumstances expands to 8·0. From this it follows that the volume of a hydrogen atom may be twenty times that of a carbon atom. Oxygen has three volumes, 2·51, 4·45, and 7·53, depending on the nature of the compound and the position of attachment to the carbon atom.

This remarkable theory of atomic volumes is explained within the limits of four pages, and the remainder of the book is occupied with the graphic formulæ of 100 organic compounds (alcohols, ethers, &c.). In these formulæ the carbon atoms are represented as oblongs divided into four portions, and the positions of attachment and the relative volumes of all the atoms are shown.

The author states that "the theoretical and experimental specific gravities never differ by more than 0·001, although different experimentalists seldom agree to more than two places of decimals." It is difficult to see how these statements can be reconciled. Moreover, the author has the choice of nine volumes for the three elements, whereas Kopp obtained a fair agreement between observed and calculated values for molecular volumes at the boiling point with one volume each for carbon and hydrogen and two volumes for oxygen; it is evident, therefore, that an agreement between observed and calculated values on the former basis can scarcely be regarded as conclusive evidence in favour of the author's theory. The theoretical discussion of the subject is quite inadequate, and it is to be hoped that some of the more obvious omissions will be repaired in the later volumes on the subject which are promised.

Forest Flora of the Siwalik and Jaunsar Forest Divisions of the United Provinces of Agra and Oudh, being a revised and enlarged edition of the Forest Flora of the School Circle, N.W.P., with Analyses, compiled for the use of the Students of the Imperial Forest College, Dehra Dun. By U. Kanjilal. Pp. xxix+457. (Calcutta: Government Printing Office, 1911.) Price 1.14 rupees for public; 1.4 rupees for students.

TEN years have elapsed since the first edition of the "Forest Flora of the School Circle, N.W.P.," was published; meantime the division of the School Circle has received other names for both forest and administrative purposes, which are given in the revised title, and the author has noted certain alterations and emendations that are desirable. The glossary has been revised, family names have been changed in accordance with the Vienna rules, an important addition has been made in the shape of an analytical synopsis of the orders and families which provides ampler details for their determination, and a general revision of the flora has been effected. The teaching experience of the author has suggested but few changes in the list of species described. Only two of the additional species incorporated are trees, *i.e. Diospyros Kanjilali* and *Linociera intermedia*; the former was described in 1905 by Duthie from material supplied by the author. These alterations will serve to increase the usefulness of this pocket flora.

Wilson's Folding Globe. Circumference 40 inches. (London: George Philip and Son, Ltd.) Price 7s. 6d. net, in cardboard box.

THIS ingenious device will prove of excellent service to teachers of geography in assisting them to correct the misleading ideas which are apt to arise in the minds of young pupils by the exclusive study of flat map projections. The mere fitting up of the globe, with the aid of the simple accessories provided, will impress upon the beginner the distortion entailed by the representation of a spherical surface on a plane. When placed flat, the "gores," which when arranged form the globe, make up an equal scale map of the world. There is sold with the folding globe a map of the world on Mercator's projection, so that a proper understanding of its advantages and disadvantages may be secured by comparing it with the equal scale map.

A Text-book of Geography. By G. Cecil Fry. Second edition. Pp. xxi+468. (London: W. B. Clive, University Tutorial Press, Ltd., 1911.) Price 4s. 6d.

THE first edition of this book was reviewed in NATURE for March 11, 1909 (vol. lxxx., p. 31). In the present edition more than thirty new maps and diagrams have been added, as well as a number of climatic data for the principal divisions of the world. A new appendix of some 350 examination questions has been introduced.

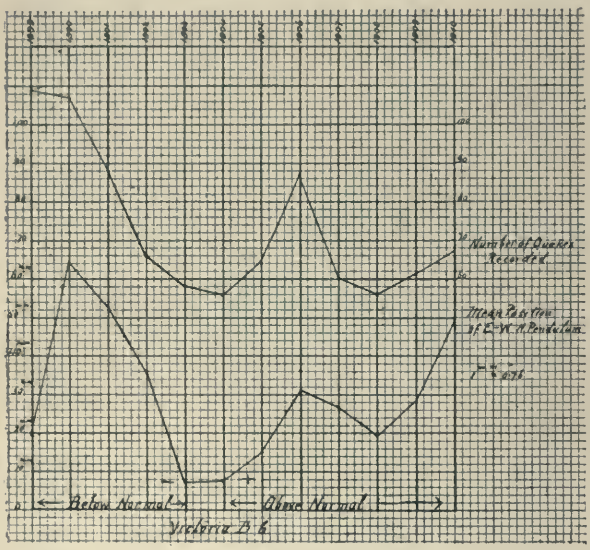
LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Irregular Long-period Changes in Level.

AT the Portsmouth meeting of the British Association Mr. F. Napier Denison contributed a paper on changes in level observed with a horizontal pendulum at Victoria, B.C. Observations commenced in January, 1899, and extended over the next eleven years. For the most part these refer to changes in level in an east-west direction. Like observers in other parts of the world, he found diurnal, annual, and other changes, all of which can be referred to epigenic influences.

Over and above these Mr. Denison pointed out that the pendulum did not annually return to its normal position; for irregular periods varying between twelve and thirty months the zero might travel eastwards, after which it would make a greater or less excursion towards the west. But here comes the interesting point. A curve of these wanderings very closely agrees with one representing the annual frequency of world-shaking earthquakes, which



have been most numerous when the pendulum was farthest removed from its normal position, whether this was to the east or west. The accompanying curves by Mr. Denison are self-explanatory.

With the object of throwing further light on these observations it would be of interest to learn whether these long-period changes in level, and, I may add, in azimuth, have been recorded at observatories which have piers on rock foundations, particularly in districts where there is reason to suppose rock folding may still be in progress. Such observatories may perhaps be found in Switzerland, Italy, the Balkans, North India, and the American and Asiatic shores of the Pacific. I have not, however, been able to find a catalogue which gives information about the foundations of astronomical observatories.

An excellent *résumé* relating to changes in the vertical is given by Sir G. H. Darwin in a report to the British Association (1882). What is now required is a *résumé* since 1899, from which date we possess a fairly complete catalogue of world-shaking earthquakes, each of which, there is reason to suppose, may be regarded as the announcement of a general relief in seismic strain, and as one earthquake may beget another, they frequently take place in widely removed districts at about the same time. If a megaseism means a relief of strain in the crust of our world, can astronomers throw any light upon its growth?

All who are interested in earth physics would like to know whether evidences of long-period changes in the vertical exist, particularly in the direction of the dip of strata on which their observatories are situated.

Shide, Isle of Wight, England. JOHN MILNE.

Solar Eclipse—April, 1912.

A FEW years ago I read a short paper before the British Astronomical Association, in which I suggested that certain eclipse observations should be made, not at the centre line of the path of the shadow, but as near as possible to its two edges; and seeing that the forthcoming eclipse is unsuitable, on account of its short duration, for the usual observations, I hope that the astronomers of Europe will devote their attention to determining the position and width of the shadow. If they can do this with the exactitude which I anticipate, then, in a single day, full information will have been collected with which a profile of the earth's surface can be drawn along a line extending from Portugal through Spain, France, Belgium, Holland, Germany, and Russia to Siberia, which profile would have the advantage that it would be unaffected by local variations of gravity.

My suggestion is that enlarging cameras should be attached to the observing telescopes, and that images of the northern and southern edges of the sun and moon should be thrown on sensitive films, which would have to be moved in a north and south direction (say at the rate of 1 mm. per second). An observer stationed outside the shadow would obtain a negative image consisting of a black band with one gap at either edge; the horizontal (east and west) distance between the edges of these gaps would be the width of the chord on the sun's disc which is traversed by the moon's north or south edge; the vertical (north and south) distance between the gaps would represent the time taken in traversing this chord. An observer stationed inside the moon's shadow would obtain a negative image, which would be a black band crossed by a white "bend," the horizontal width of which would represent the length of the chord on the moon's disc traversed by the edge of the sun, and the vertical distance would represent the time taken in traversing this chord.

The length of the chord being known either by measurement or by calculation from the time, the overlapping of the northern or southern edges of the sun and moon could easily be calculated. The moon's apparent semi-diameter is about 1000″, and its actual semi-diameter about 1000 miles. If the enlargement be such that 1 mm. = 1″, then if one of the observers should find that the length of the chord is, say, 100 mm. on the film, equal to 100″, or 100 miles, then the amount of overlap is $50^2 : 2000 =$ 1·25 mm., ″, or miles, and he will know that he was stationed one and a quarter miles, or 2 kilometres, from the edge of the shadow. A more fortunate observer, who may obtain a length of chord of only 10 mm., would know that he was stationed at one-eightieth of a mile from the edge. If, as seems likely, the photographic records can be measured with an accuracy of one-fifth millimetre, then the latter observer will feel sure of his position to within one two-thousandth of a mile, or, say, to within 1 metre.

As the angle at which the shadow strikes the earth will nowhere be less than, say, 50°, it is evident that a small difference of level of only a few metres between two observers would make a perceptible difference in their photographic records, and these would, therefore, afford the means for accurately fixing their relative heights along a line extending from Portugal to Siberia. Future eclipses, both total and annular, would enable a network of such profiles to be determined not only across continents, but also across oceans. C. E. STROMEYER.

"Lancefield," West Didsbury, October 25.

Khartoum for an Observatory.

AT a time when search is being prosecuted in northern Africa (NATURE, September 21, p. 393) for an observatory site, it may not be out of place to direct attention to the merits of the Khartoum vicinity, so far as this can be done by one who is not an astronomer. Its features may be enumerated as follows:—

Position.—Latitude 15° 36′; it is some degrees nearer

the equator than Salisbury in Rhodesia. The importance of a low latitude has been illustrated by the success of Helwan Observatory in obtaining the earliest photograph of Halley's comet, owing to the longer night near Cairo in summer as compared with Greenwich or Heidelberg. This advantage would be still further marked in the case of Khartoum, some $14\frac{1}{4}°$ south of Helwan, or relatively about as far as Barcelona is from Edinburgh.

Altitude.—Precise determinations have been made by levelling, and the land near the river has been found to stand about 385 metres above sea-level.

Climate.—So far as I am aware, the "seeing" qualities of the atmosphere have not been tested. Ordinary experience shows that it is remarkably clear, and it is no uncommon thing near the Italian boundary in these latitudes to see Jebel Kassala (4400 feet) and some of the Eritrean hills at distances up to a hundred miles. These districts are at no great height above sea-level, and the clearness of vision must in large measure be due to the pureness and homogeneity of the air.

Relative humidity is a factor presumably of great importance as regards the "seeing" qualities of the air; and those interested may refer to Captain Lyons's "Physiography of the Nile and its Basin," where they will find the data for Khartoum and many other stations concisely summarised. More recent data are available in the annual meteorological reports, &c., published by the Egyptian Survey Department. Suffice it to say that the mean annual relative humidity is 31 per cent., and this figure is only exceeded for three months in the year. The Khartoum observations have been made within a short distance of the river, and no doubt the humidity results are higher than would have been obtained at a station a mile or two away. The air is often dry enough, even near the river, to desiccate moist calcium chloride. There are very few cloudy nights.

During the summer months violent dust-storms occur, but these are generally of short duration. Situated on the southern edge of the desert, it has a rainfall of about 6 inches a year, almost confined to the months of August and September. Temperature conditions are extreme, but owing to the intense dryness heat is seldom oppressive to the individual.

Communication.—Several mails a week carry letters to London in nine or ten days, and the outward journey can be done in eight and a half days. The railway to the Red Sea enables goods from outside to reach Khartoum with only a single handling at Port Sudan.

It seems improbable that there is any other locality in an equally low latitude offering the advantages of a clear, dry atmosphere combined with a fair altitude and such ready means of communication with European centres of learning. As an actual site in this vicinity the Abu Meru Hills may be suggested, as rising about 100 metres above the river at a distance of some eight miles north-west from Omdurman. The place is far enough to avoid any local humidity due to the river, as well as the dust-raising traffic converging on the towns. The prevalent winds are from the north and north-west, and traverse hundreds of miles of unbroken desert before reaching the hills.

In conclusion, I have to thank Mr. Rolston for directing my attention to the search being undertaken by the French Geographical Society. Our friends across the Channel have extensive possessions in northern Africa, and no doubt these have first claim for consideration; but if they are unable to exploit Khartoum, perhaps it may be kept in view and tested when munificence can be found to provide for the equipment and maintenance of a new observatory.

G. W. GRABHAM.

Khartoum, Sudan, October 15.

The Scientific Misappropriation of Popular Terms.

I ENTIRELY agree with Dr. Harmer (NATURE, October 26) that the extension of priority to groups larger than genera is undesirable, and the use of the word insect should be judged solely by practical convenience.

If the restricted use of the word insect were as generally accepted as that of deer there would be no objection to its use. I understand, however, that the use of deer for small mammals was abandoned in Middle English, and that the phrase "mice and rats and such small deer," quoted by Dr. Harmer, was intended by Shakespeare and later authors to be a joke, like the railway porter's classification of the tortoise as an insect.

The same explanation is not available for the remark in Prof. Adam Sedgwick's "Text-book of Zoology" (vol. i., p. 502) that "all spiders are predaceous and suck the juices of other insects."

I cannot agree with Dr. Harmer that the word insect is, or ever has been, generally used in the restricted sense either in popular literature or in technical works other than zoological. For example, agriculturists always seem to speak of insect in the wider sense, and agricultural literature generally does the same. Nor do I find any agreement on the subject among zoologists, and the tendency seems to be for them to abandon Insecta as a class name in favour of Hexapoda. Sir Ray Lankester expresses the matter admirably in the new edition of the "Encyclopædia Britannica." He rejects Insecta as the class name of the "so-called 'true insects,'" and regrets that Lamarck, who invented the "very appropriate name Hexapoda," did not insist on it; and "so the class of Pterygote Hexapods came to retain the group-name Insecta, which is, historically or etymologically, no more appropriate to them than it is to the classes Crustacea and Arachnida." He refers with obvious disapproval to "the tendency to retain the original name of an old and comprehensive group for one of the fragments into which such group becomes divided by the advance of knowledge, instead of keeping the name for its logical use as a comprehensive term, including the new divisions, each duly provided with a new name" (Sir Ray Lankester, "Encyclop. Brit.," vol. ii., 1910, p. 673).

Those, therefore, who use the word insect in its older and etymologically more correct sense have the support of high zoological authorities.

J. W. GREGORY.

4 Park Quadrant, Glasgow, October 28.

The Colour of a Donkey.

ON October 5, at 7 p.m., the moon being high up and almost obscured by a thick high haze, giving a diffused ground light with no shadows, I was crossing an open field by a footpath. The field is about a quarter of a mile across, and the hedges all round it, with tall elms, were marked out in broad dark masses. The grass, dried by the hot summer, is straggly and grey, with short green undergrowth. There were a number of cows—red and red and white—scattered over the field, visible in the dim light up to 80 yards by measurement. One could apparently see everything within that radius.

I was brought to a halt by hearing an absolutely invisible animal noisily cropping the grass a few feet away. On going nearer I found a grey donkey. On his starboard quarter at 4 yards' distance his dark head appeared as a moving blur, but "stern on" at that distance he was completely invisible—an "airy nothing"—though, like Polonius, "at supper." It was most extraordinary to hear the animal feeding and to be unable to see a vestige of him. At 2 yards' distance he was a mere ghost. The lighter under-colour of the ventral surface certainly diffused what light there was, after the manner of the vanishing duck in the Oxford Museum. That may be partly the explanation.

Returning by the same path at 7.30, I tried by walking across the field in every direction to find the donkey, but failed, though the cows were all plainly visible, feeding or lying down, and the donkey was in the field all night.

The striped zebra, invisible in the moonlight, is cited as an example of protective coloration. I merely record the above facts without venturing upon any explanation of them.

There is an old rhyme describing the palpitations of a villager followed at night across a field by an invisible creature with audible footsteps—

"And much he feared that dreadful ghost
Would leap upon his back."

That was also a donkey, and the rhyme, like Gilpin's ride, may be the jocular record of a fact. My donkey was ghostly enough, and suggests possibilities.

Waterstock, October 24.

E. C. SPICER.

Non-Euclidean Geometry.

As many mathematicians give very little thought to the theory of sets, it is perhaps worth while dwelling for a moment on Dr. Sommerville's possibly misleading remarks in NATURE of October 5. He, quite correctly, points out the one-one correspondence between the aggregates of integral numbers 1, 2, 3, &c. (n), and even numbers 2, 4, 6, &c. ($2n$). Thus the part appears equivalent to the whole. This statement loses the character of a paradox to all who will bear in mind that the notion of "the part cannot equal the whole" has its origin in the contemplation of *finite* quantities.

Again, the sets of numbers of the form $4n$ and $4n+2$ constitute aggregates of the same type; they are equivalent to each other as well as to n itself and $2n$. I fail to see that Dr. Sommerville shows the part to be larger than the whole. An aggregate A would be larger than A′ if A contained a set equivalent to A′, while A′ does not contain a set equivalent to A.

HAROLD M. SADOW-PITTARD.

SS. *Caledonia*, October 14.

IN drawing a parallel between Legendre's proof and the paradox concerning infinite aggregates, I had not thought it necessary to point out the fallacy, which consists, as in Legendre's proof, of transferring to infinities notions which are derived from a study of finite magnitudes.

Of the two propositions, a part is (1) equal to, and (2) greater than, the whole; the one is just as much a paradox as the other until the meaning of the terms equal, greater, and less has been extended and modified for infinite aggregates; and the proofs which I gave are equally in accordance with notions derived from finite aggregates. Neither of them was intended as a valid proof, though the first happens to be in agreement with the usual extension of the meaning of equivalent. D. M. Y. SOMMERVILLE.

The University, St. Andrews, October 23.

Dew-ponds and the Dry Season.

WITH reference to the remark in NATURE of October 26 (p. 559), I paid a visit to the Chanctonbury Dew-pond about the end of last August, and was surprised at its flourishing condition.

The water-level was, of course, much below the normal, and the surrounding water plants were much trodden under by sheep and cattle. There still remained, however, a good fringe, and the usual pond plants seemed to be in a satisfactory state. I could not get to the water's edge owing to the moist and boggy nature of the ground, usually submerged.

Some other dew-ponds met with in the course of a few days' walk west of Chanctonbury were quite dry, so far as I remember. J. P. CLATWORTHY.

University College, Reading, October 30.

CHARLES DARWIN'S EARLIEST DOUBTS CONCERNING THE IMMUTABILITY OF SPECIES.

IN view of the great revolution in scientific thought which was inaugurated by the publication of the "Origin of Species," the story of the evolution of ideas in the mind of its author must always have a deep fascination for the student of the history of science—and the question of the nature of the initial stage of that evolution is one especially worthy of attention.

In his autobiography, Charles Darwin has declared his belief that, before leaving England for the memorable voyage in the *Beagle*, he was quite indifferent to any speculations upon the subject of evolution—and this in spite of his admiration for his grandfather's "Zoonomia" as a literary production.[1] Now concerning the exact period in his life when Darwin ceased to feel this indifference, and had his interest aroused by that "mystery of mysteries"—to the solution of which his whole after-life was to be devoted—there have been very marked differences of opinion.

Huxley stated his conviction to be that no really important fruits of the observations made during the voyage of the *Beagle* could have been gathered by the ardent but untrained young naturalist until after he reached England, and had the opportunity of consulting specialists concerning the specimens which had been sent home by him from time to time.[2] But, on the other hand, Dr. Francis Darwin and Prof. Seward maintain that during the voyage, and especially towards its close, when the Galapagos Islands were visited, Darwin's observations and his meditations upon them had already begun to bear fruit, and had led him to lose his absolute faith in the immutability of species.[3] I am myself convinced, as the result of a careful consideration of letters written at the time, that *very early indeed in the course of the voyage* certain observations and reflections had given rise in Darwin's mind to *serious misgivings* concerning the fixity of species, although, writing nearly fifty years afterwards, he dismissed them lightly as nothing more than "*vague doubts*."

It was this statement in Darwin's correspondence to which Huxley appears to have attached very great importance. It occurs in a letter to Dr. Zacharias and is as follows:—

"When I was on board the *Beagle* I believed in the permanency of species, *but as far as I can remember, vague doubts occasionally flitted across my mind*."[4]

It should be borne in mind, however, that as these lines were written as late as 1877, to one of his very numerous casual correspondents, we may not improbably infer that Darwin penned them somewhat hastily and without any deep thought or reflection concerning the interpretation that might be put upon them if published. For it must be remembered that nearly twenty years before this he had written and *printed* the following:—

"When on board H.M.S. *Beagle* as naturalist, I was *much struck* with certain facts in the distribution of the inhabitants of South America, and *in the geological relations of the present to the past inhabitants of the continent*."[5]

Seeing that these words form the first sentence of the introduction to the "Origin of Species," and must therefore have expressed the result of very deliberate thought and consideration, that they would certainly have been frequently scanned by the author before publication, and that they are repeated without change or qualification in every succeeding edition of the book, it is undoubtedly only fair to attach far greater weight to them than to a sentence hastily indited to a casual correspondent so many years afterwards.

In that marvel of candid introspection, the "Autobiography," Darwin wrote in 1876 as follows:—

"During the voyage of the *Beagle* I had been *deeply impressed* by discovering in the Pampean formation great fossil animals covered with armour like that of the existing armadilloes."[6]

And this he enumerates as the *first*, though *not the most important*, of the observations which turned his thoughts in the direction of evolution during the voyage. When writing to Haeckel in 1864 he says:—

"*I shall never forget my astonishment* when I dug out a gigantic piece of armour like that of the armadilloes."[7]

Owing to a singular blunder, for which Darwin was in no way responsible, I shall have to point out that

1 "Life and Letters of Charles Darwin," vol. i., p. 38.

2 "Collected Essays," vol. ii., p. 271.

3 "More Letters of Charles Darwin," vol. i., pp. 37-39. See also "Foundations of the Origin of Species," p. xv.

4 "More Letters of Charles Darwin," vol. i., p. 367. The italics in this and succeeding passages are our own.

5 "Origin of Species," p. 1.

6 "Life and Letters," vol. i., p. 82.

7 "History of Creation," vol. i., p. 134.

the significance and importance of this *fateful* discovery—for such I believe it to have been—has to some extent been overlooked; but concerning the time and place that it was made, and all the circumstances connected with it, we fortunately have ample information.

During the first six months that he spent in South America (March to September, 1832), Darwin tells us that he had "procured a nearly perfect collection of mammals, birds, and reptiles" in the districts around his two great centres of work at this time, namely, Botofogo Bay, near Rio de Janeiro, and Maldanado, near Monte Video.[8] In doing this he could not fail to be greatly struck by the peculiarities of the fauna, with its sloths, ant-eaters, and armadilloes. From the journals both of Fitzroy and Darwin, we learn that questions concerning the several species of armadilloes and their geographical range were at this time engaging their attention.[9]

It fortunately happened that, during the autumn of 1832, the *Beagle* was delayed for some weeks in Blanco Bay. The energetic young captain (Fitzroy was at this time twenty-seven years of age, only four years older than Darwin himself), finding that, in his own ship, he could not safely survey the shallow waters of the South American coast, purchased, at his own expense, two tiny undecked sealing craft and placed them under the command of two of his officers who volunteered for the service. While the alteration, refitting, and rigging of these dirty little vessels was in progress, the *Beagle* was delayed at her anchorage, and Darwin found an opportunity of which he took splendid advantage.

Near Punta Alta, on the shores of the Bay of Bahia Blanco, there is a cliff about 20 feet high extending for the distance of a mile; the beds exposed in this cliff consist of false-bedded gravel, sand, and marl, in which were many shells which Darwin recognised as belonging to existing species. But in the midst of these sands and gravels could be seen a lenticular bed of red mud, in which the bones of great quadrupeds occurred in such abundance that remains of nine large mammals were disinterred from an area of 200 square yards.[10]

Under the date of September, 1832, Captain Fitzroy wrote in his journal as follows:—

"My friend's" (Darwin's) "attention was soon attracted to some cliffs near Point Alta, where he found some of those huge fossil bones, described in his work, and notwithstanding our smiles at the cargo of apparent rubbish which he frequently brought on board, he and his servant used their pick-axes in earnest,. and brought away what have since proved to be most interesting and valuable remains of extinct animals."[11]

Doubtless, while his other shipmates were content with exhibiting mild amusement at the eagerness of "the Flycatcher," as Darwin was called by them, the martinet first-lieutenant, as is recorded in the "Life and Letters," would be moved to wrath by the state to which his decks were being reduced by these strange proceedings, and driven to employ choice nautical language concerning "the d——d beastly devilment," not forgetting to add, "If I were skipper, I would soon have you and all your beastly mess out of the place."[12]

It was probably on this occasion that Darwin experienced those pangs of "despair with which he had to break off the projecting end of a huge, partly excavated, bone, when the boat waiting for him would wait no longer"—a sorrow which, as his son tells us, he often recalled and spoke of in after-life.[13]

We must bear in mind that Darwin collected from this treasure-house of mammalian remains at Punta Alta on two different occasions, first in September, 1832, and secondly in August, 1833.

That it was on the *first* of these occasions "the gigantic piece of armour like that of the armadilloes was procured" is fortunately proved by a letter written by Darwin to Henslow, dated November 24, 1832, and communicated to the Cambridge Philosophical Society before the *Beagle* had returned to England.[14] The opportunities which the young naturalist then enjoyed of having boats and men at his disposal to transport these great bones of the Pampas formation to the ship, appear to have been unique.

In the very important letter to which I refer, Darwin speaks of finding "fragments of at least six different animals," including "a large surface of the osseous polygonal plates, which 'late observations' (what are they?) show belong to *Megatherium.*" In writing thus, Darwin was evidently, to some extent, the victim of a mistake into which naturalists had been betrayed at the beginning of last century. Whether, in using the words, placed between inverted commas by him, Darwin was quoting from some author, I have vainly endeavoured to discover by an examination of the books which he would probably have in his little library on the *Beagle*; but the query, which he puts in brackets, clearly shows that he suspected that an error had been committed. And this conclusion is confirmed by the sentence which follows:—

"Immediately I saw this I thought they must belong to an enormous armadillo, living species of which genus are so abundant here."

The history of the origin and spread of the idea that the dermal armour of the Glyptodonts belonged to the Megatherium is a very curious one.

It has been suggested that Dr. Buckland was responsible for the unfortunate error,[15] but the passage quoted in support of this view is taken from the "Bridgewater Treatise," which was not published until 1836, and indeed contains a reference to Darwin's own work in South America. Buckland, like other geologists and zoologists of that day, merely followed the lead of Cuvier in this matter.

The remains of the gigantic fossil sloths of South America had found their way to Europe before the end of the eighteenth century, and both Megatherium and Mylodon were described by Cuvier in his "Ossemens fossiles" in 1812. But while preparing the fifth volume of the second edition of that great work in 1823, he received from a colleague, the botanist August de Saint-Hilaire, a letter sent with specimens from South America, by D. Damasio Larranãga, curé de Montevideo. This letter, apparently without being carefully scrutinised by Cuvier and his assistants, was printed in a footnote,[16] and contains the words "Je ne vous écris point sur mon dasypus (Megatherium, Cuv.)." The worthy priest, who was evidently not a zoologist, confounded Dasypus (the armadillo) with the Megatherium; and, strange to say, Cuvier not only allowed the passage to stand, but added the suggestion that Megatherium might have possessed bony armour like the armadillo, and that he awaited impatiently further information on the subject from Larranãga. As bones of the giant sloths from South

8 "Journal of the *Beagle*" (1839), p. 46.
9 "Voyages of the *Adventure* and *Beagle*," vol. ii., p. 107; vol. iii., p. 113.
10 "Geological Observations on South America" (1846), pp. 82–85.
11 "Voyages of the *Adventure* and *Beagle*," vol. ii., pp. 106–7.
12 "Life and Letters of Charles Darwin," vol. i., p. 223.

13 *Ibid.*, vol. i., p. 276, *note*.
14 This letter was read at a meeting held on November 16, 1835, and was privately printed.
15 "More Letters of Charles Darwin," vol. i., p. 12, *note*.
16 "Ossemens fossiles," second ed., vol. v. (1823), p. 191, *footnote*.

America were often accompanied by portions of the bony armour, which occur in the same deposit, it is perhaps not surprising that the erroneous identification was caught up and repeated in other works on the subject.

It was not until 1840 that Owen in this country and Lund in Germany established the existence of the several genera of the Glyptodontidæ, and showed that these bony plates really belong to extinct forms allied to the armadilloes. It is therefore very interesting to find that the "untrained" naturalist of twenty-three years of age had divined the real truth on the subject so long before.

The specimen which excited such intense interest in Darwin's mind was described by him in 1846, after consultation with Owen, as follows:—

"A double piece, about three feet long and two wide, of the bony armour of a large Dasypoid quadruped, with the two sides pressed nearly close together: as the cliff is now rapidly washing away, this fossil was probably lately much more perfect; from between its doubled-up sides, I extracted the middle and ungueal phalanges, united together, of one of the feet, and likewise a separate phalang: hence one or more of the limbs must have been attached to the dermal case when it was embedded." [17]

This fine specimen, which would undoubtedly have been of great historical interest, from the effect it produced on the young naturalist's mind, is unfortunately no longer in existence. Darwin says "It was so tender that I was unable to extract a fragment more than two or three inches square." [18] Owen, in his memoir on the fossil bones sent home by Darwin, describes and figures two small fragments—"the portions of the tesselated bony dermal covering of a Dasypoid quadruped," and these are identified as belonging to the specimen in question by the statement that they "were discovered folded round the middle and unguel phalanges," which are also figured on the same plate.[19]

As evidence of the special interest which Darwin attached to this discovery, it may be mentioned that he at once sent home a fragment of this (or of a similar specimen) to his family, for we find him writing to his sister Catherine, on May 22, 1833:—"I am quite delighted to find the hide of the Megatherium" (he uses the term by which such specimens were then generally known) "has given you all some little interest in my employments." [20]

Now, in order to appreciate the extraordinary effect of this discovery on young Darwin's mind, we must remember what were the opinions current among geologists when it was made. The views of Cuvier at that date were regarded as not less authoritative in geology than they were in zoology, and in the introduction to his *magnum opus*, the "Ossemens fossiles," the opinions of the great comparative anatomist were pronounced with no uncertain note. He contended that each geological period must have been brought to a close through the sweeping out of existence, by a great cataclysm, of all plant- and animal-life, this being followed by the creation of a perfectly new assemblage of living beings. Cuvier's teaching was made as widely known in this country as it was on the Continent, for Jameson issued a number of editions of a translation of the famous introduction, under the title of "An Essay on the Theory of the Earth"; and, as von Zittel justly remarks, "Cuvier's catastrophic theory was received with special cordiality in England." [21] By none certainly was it adopted more unreservedly than by Darwin's teachers and friends, Henslow and Sedgwick.

17 "Geological Observations in South America" (1846), p. 84.
18 *Ibid.*, p. 86.
19 "Zoology of the *Beagle*," "Fossil Mammalia,' plate xxxii., and description.
20 "Life and Letters of Charles Darwin," vol. i., p. 245.

Among the books in Darwin's library, now piously preserved at Cambridge, is a copy of the fifth edition of the translation of Cuvier's "Essay," bearing the date of 1827,[22] and I think there can be no doubt that this book was one of those constituting the little library of reference in the chart-room of the *Beagle*, where Darwin worked and slept. Nor can there be any hesitation in concluding that with the contents of this book he would be thoroughly familiar.

This being the case, Darwin found himself confronted at Punta Alta with the two startling facts which he so clearly indicates in his letter to Henslow.

First, the bones of gigantic and undoubtedly extinct mammals were seen to be associated in the same deposit with shells of living species. He tells Henslow at the time, "They" (the bones) "are mingled with marine shells which appear to me identical with what now exist." (He, in fact, collected twenty-five species, all of which D'Orbigny afterwards pronounced to be still living.) How, on Cuvier's theory, could such a state of things arise? The cataclysm that destroyed the mammalian must surely have been equally fatal to the mollusca!

But the *second* fact was even more striking and significant. Not only did Darwin obtain the armour of "an enormous armadillo," but among the other remains he identified the jaw of another of the Edentata, and the teeth of rodents similar to those now living in the district.[23] His recent collections had made him familiar with the peculiar mammalian fauna of South America, and the striking characters which distinguish it from that of all other portions of the globe, and here, he states, was evidence before his eyes that the mammals of the period immediately preceding our own, though differing in being more gigantic, presented a striking family likeness to them. This was a fact quite inexplicable on the theory of wholesale destructions and brand-new creations, but most suggestive, and capable of simple explanation, if the recent forms were descended from the fossil ones, or both were representative of common ancestors.

When Charles Darwin arrived home in 1836, and engaged in the preparation of his journal for publication, he found that almost simultaneously with his own discovery a similar one had been made with respect to the Australian continent. Clift had identified a number of bones collected in caves in that island as belonging to extinct marsupials, and Jameson had pointed out the significance of their relations with the existing fauna.[24] There can be no doubt, however, that Darwin was quite unaware of this publication while he was in South America, though he refers to it in writing up his journal. Facts like these, so familiar to us at the present day, were then quite novel.

But it is by no means improbable that the mind of the young naturalist was in a specially receptive condition, when it encountered the shock of this important discovery. Darwin has again and again insisted on the revolution produced in his mind on geological questions by the study of the first volume of Lyell's "Principles of Geology," which he took

21 "History of Geology and Palæontology" (English translation), p. 141.
22 "Catalogue of the Library of Charles Darwin," p. 19.
23 "More Letters of Charles Darwin," p. 12.
24 "On the Fossil Bones found in Bone Caves and Bone Breccias in New Holland," *Edinb. New. Phil. Journ.*, vol. x. (1831), pp. 390–7. In this paper the list of species is by Clift, but the remarks are by the editor, Jameson. The arguments are somewhat weakened by the larger marsupial bones having been mistaken for those of elephant or rhinoceros. It is remarkable that most authors, including Darwin himself, give Clift the credit for the generalisations, but this is not borne out by an examination of the paper.

with him from England. In his dedication of the second edition of his "Journal," Darwin wrote, "The chief part of whatever scientific merit this journal and the other works of the author may possess has been derived from studying the well-known and admirable 'Principles of Geology.'"[25]

In a letter to his friend, at the same time, Darwin clearly explains the nature of his indebtedness to the "Principles." He says, "Those authors . . . who, like you, educate people's minds as well as teach them special facts, can never, I should think, have full justice done them except by posterity, for the mind thus insensibly improved can hardly perceive its own upward ascent."[26] And shortly before this he had written to Leonard Horner, "I have always thought that the great merit of the *Principles* was that it *altered the whole tone of one's mind*, and therefore that, when seeing a thing never seen by Lyell, one yet saw it partially through his eyes."[27]

It has been pointed out, both by Huxley and Haeckel, that when Lyell had completed the first volume of his great work he had arrived at the logical conclusion that the same principle of continuity or uniformity which he had demonstrated for the inorganic world must apply also to organic nature and even to man. This is clearly shown in the correspondence that has been published,[28] which also makes it manifest that some among Lyell's contemporaries who thought deeply on the subject could not avoid the same conclusion. Sedgwick clearly perceived this, and it moved him to rage and to making wild charges of "infidelity." Whewell saw it too, and shrank from accepting Lyell's doctrines because he could find no border-line between what he called "uniformitarianism" and evolution; but Herschel appears, at the time, to have been ready to go as far as Lyell himself. And the young naturalist on board the *Beagle*, did he begin to perceive, however dimly, "through Lyell's eyes" that evolution could not stop with the inorganic world? We have no evidence on this point; we can only conjecture it as possible.

This much, however, is certain, that Darwin, after completing his excavations at Punta Alta, returned to Monte Video, and among the articles sent from home which were awaiting him there, found the second volume of the "Principles," and wrote in it "Monte Video, November, 1832." The volume treats of the "Changes in the *Organic* World now in Progress." It is true that Lyell had been so far influenced by his friend Cuvier that he commenced the book with a very trenchant criticism of the theory of Lamarck, but he then goes on to discuss a number of problems of extreme interest and importance to the evolutionist—the limits between species and varieties; variation under domestication and in nature; the effects of crossing and the characters of hybrids; the geographical distribution of plants and animals, and the agencies by which it has been brought about; extinction and the appearance of new forms; the struggle for existence; the origin of instincts; and the bearing of all these and similar questions on the interpretation of the geological history of past times. Great as was the influence of the first volume on the mind of Darwin with regard to geological questions, I think no one can now read this second volume without realising that, in respect to biological problems, it must have exercised at least an equally profound effect upon him. It could be easily shown from the "Journal" that all these problems were, from this time forth, ever in Darwin's thoughts, and as new observations were made by him, he delighted to think, as shown by his letters, that they would "interest Mr. Lyell," who was at that time not personally known to him.

I am very far from suggesting that the collection of the fossil bones at Punta Alta and the perusal of Lyell's second volume made Darwin an evolutionist. On the contrary, I fully admit, with Dr. Francis Darwin, that it was the series of wonderful relations revealed to him towards the end of the voyage, by his study of the faunas of the Galapagos Islands, that had the preponderating influence in moulding Darwin's views; and I am convinced that anything like a definite formulation of those views did not take place until after his return to England. It was then that, by the re-examination of his collections and the revision of the observations in his notebooks and journal, he was led to bring into close array the various facts and reflections bearing on "the species question," and thus the scattered gleams of light on the subject which he had from time to time caught were first brought to a focus in his mind; nevertheless, it is true that the first of those gleams were those that came to him at Punta Alta and during the perusal of the "Principles."

There is a passage in one of Darwin's letters to Bentham the significance of which, I think, has been somewhat overlooked. Speaking of the fluctuations of opinion on the question of the immutability of species, he says:—

"I, for one, can conscientiously declare that I never feel surprised at anyone sticking to the belief of immutability. . . . I remember too well my endless oscillations of doubt and difficulty. It is to me really laughable, when I think of the years which elapsed before I saw what I believe to be the explanation of some parts of the case; I believe it was fifteen years after I began before I saw the meaning and cause of the divergence of the descendants of any one pair."[29]

Fifteen years after 1832 would bring us to 1847, a period at which Darwin was fully immersed in the task of "making and unmaking species" among the Cirripedes, and in their classification; and it may well have been the consideration of "one pair" of these that led him first clearly to realise "the meaning and cause of divergence." In his autobiography he wrote, "Long after I had come to Down" (which was in 1842) "whilst in my carriage to my joy the solution occurred to me," and "I can remember the very spot in the road."[30] Although, as Dr. Francis Darwin has shown,[31] his father had come very near to this idea of divergence when he wrote the 1842 sketch,[32] and the same is true with regard to the essay of 1844,[33] it was clearly after these dates that the full significance of the principle revealed itself to his mind, and that it was the result of pondering on questions of classification is shown by his letter of September, 1857, to Asa Gray, which he communicated to the Linnean Society in 1858. He there wrote:—"Each new variety or species when formed will generally take the place of and so exterminate its less well-fitted parent. This I believe to be the origin of the classification or arrangement of all organic beings at all times."[34]

If this reasoning be correct, we obtain the date of a crisis in Darwin's mental development to which he himself attached the greatest importance. However this may be, the letter to Bentham proves what is often overlooked, that Darwin's mind vacillated

25 "Naturalist's Voyage Round the World" (1860).
26 "Life and Letters of Charles Darwin," vol. i., pp. 337–8.
27 "More Letters of Charles Darwin," vol. ii., p. 117.
28 "Life and Letters of Charles Lyell," vol. ii., pp. 36, &c.

29 "Life and Letters," vol. iii., p. 26.
30 *Ibid.*, vol. i., p. 84.
31 "Foundations of the Origin of Species," p. xxiv.
32 *Ibid.*, p. 37.
33 *Ibid.*, pp. 208–11. See also "Origin of Species" (1859), chap. xiii.
34 "Linnean Society-Darwin-Wallace Celebration," p. 97.

for many years before reaching full conviction on the question of evolution. Nor is this surprising; no one can read the suggestive series of letters to Sir Joseph Hooker without realising how great and numerous were the "doubts and difficulties" through which the veteran botanist battled his way towards final acceptance of his friend's views. The publication of the Lyell correspondence showed that the author of the "Principles" at the time of the publication of the first volume was perfectly satisfied as to the truth of organic evolution; this has been insisted upon both by Huxley and Haeckel. Yet, while writing his second volume, Lyell fell so strongly under the influence of Cuvier (whose palæontological work naturally fascinated him) that he not only rejected Lamarck's hypothesis, but at times seemed to hesitate about the evolutionary theory altogether. Again, no one reading Herschel's address to the British Association in 1845, in which the "Vestiges" is so severely handled, could realise the fact that in 1836 he was writing to his friend Lyell that he was satisfied that the principle of continuity was applicable to organic as well as inorganic nature. It is no disparagement to either of these great thinkers to admit that, while weighing carefully the arguments for and against evolution, they inclined sometimes towards one side and at other times to the opposite view, and, in the words of Darwin, underwent "endless oscillations of doubt and difficulty."

JOHN W. JUDD.

ANTHROPOLOGICAL RESEARCH IN NORTHERN AUSTRALIA.

ALL friends of anthropology will rejoice to learn that after an interval of some years Prof. W. Baldwin Spencer, F.R.S., has resumed his researches among the aborigines of Australia. The following particulars as to his work and his plans are extracted from a letter addressed to Mr. J. G. Frazer on September 13.

The Commonwealth Government of Australia is about to undertake measures for the settlement of the Northern Territory, and during the present year it sent a small party to make preliminary investigations in that region. The leadership of the party was entrusted to Prof. Baldwin Spencer. The members of the party went to Port Darwin, and from there across to Melville Island; then they returned to Port Darwin and travelled south about two hundred miles, after which they crossed the continent to the Gulf of Carpentaria. Amongst all the tribes examined by the expedition the belief in the reincarnation of the dead is universal, and the same is true of the notion that sexual intercourse has nothing, of necessity, to do with the procreation of children. "The latter fact," says Prof. Spencer, "is interesting because we now know that this belief exists amongst all the tribes extending from south to north across the centre of Australia." On the other hand, Prof. Spencer found among these northern tribes none of the *intichiuma* or magical ceremonies for the multiplication of the totems which form so important a feature in the totemism of the central tribes; nor could he discover any restrictions observed by the natives in regard to eating their totemic animals and plants. "The absence of *intichiuma* ceremonies," he adds, "is doubtless to be associated with the fact that the tribes in the far north live under conditions very different from those of the central area. They never suffer from drought or lack of food supply. This seems to show that the *intichiuma* ceremonies are a special development of tribes that live in parts such as Central Australia, where the food supply is precarious."

In one or two tribes along the Roper River a very curious totemic system was discovered. Among these people a man must marry a woman of a particular totem, but the children take a totem different from both that of their father and that of their mother. For example, a man of the Rain totem must marry a woman of the Paddy-melon (a species of small kangaroo) totem, and their children are of the Euro (a species of kangaroo) totem. Again, a Porcupine man marries a Lizard woman, and their children are Bats. In these tribes each exogamous class has certain totems associated with it. Again, in these tribes the natives are convinced that the spirit children know into what woman they must enter, so that the offspring shall have the proper totem. Everywhere, too, among the tribes traversed by the expedition, the women and children believe that the sound of the bull-roarer is the voice of a great spirit who comes to take away the boys when they are initiated; but during the initiatory ceremony, when the boys are shown the *churinga* for the first time, they are informed that the noise in question is not made by a spirit, but by the *churinga*, or bull-roarer, which was used in the past by one of the mythical ancestors of the tribe. Lastly, Prof. Spencer could detect among these tribes no trace of anything like a belief in a supreme being. On the whole, he considers that, with minor variations, the beliefs of these northern tribes are closely similar to those of the central tribes.

Prof. Spencer hoped to start about November 1 for another expedition to Melville Island, the inhabitants of which he is particularly anxious to study, as they are hitherto practically uncontaminated by European influence. His intention is to reside among them until February. All anthropologists will look forward with keen interest to the publication of Prof. Spencer's fresh inquiries in this promising region. It is much to be regretted that his former colleague in research, Mr. F. J. Gillen, has been prevented by the state of his health from taking any part in these new investigations.

THE TAAL VOLCANO.

THE latest publication received from the Weather Bureau of the Philippines is entirely devoted to a violent eruption of the Taal Volcano, which took place on January 30 of this year. This volcano, which lies thirty miles south of Manila, is represented by a crater in a small island which rises from the centre of Lake Bombon. As this lake joins Taal in its activities it also must be regarded as an active crater. If its waters could be removed by the deepening of the channel of the river which now drains it, we should have a replica of Mount Aso, in South Japan, viz., a large crater about twelve miles in diameter with an active cone in its centre. The craters of these two mountains rank among the largest of which our world can boast, but they are by no means comparable with the largest in the moon. If, however, the crater plains of Taal and Aso could be lowered to the level on which these mountains grew, they would closely resemble many lunar volcanoes.

The written history of Taal commences in 1572. Since that time the volcano has been fifteen times in eruption, the last being that now under consideration. Often it has obliterated hamlets and villages round the lake, but its last effort has practically cleared out everything. The number of dead is given as 1335, but because so many were buried beneath the ash and mud the exact number will never be determined. Of all the inhabitants round the lake the only survivors appear to have been those who were absent from their

homes. It was exactly the same in 1888, when an innocent grass-covered mountain called Bandai, in Central Japan, blew away its head and shoulders and filled up a valley thirteen miles in length with mud and stones. It buried everything.

Now these calamities are not always such sudden visitations as is popularly supposed. Most, but not all, dogs growl before they bite. Bandai, although it had not erupted for more than a thousand years, gave premonitory signals. From time to time it rumbled and slightly shook. Krakatoa, before it blew three-quarters of an island to the four winds, and opened a red-hot mouth at sea-level to fight two oceans, issued signals of uneasiness. So it was with Taal. On January 27, 1911, it seems to have been the origin of 24 small shocks. Next day the number increased to 197, and on January 29, 113 were counted. What came next we are not told, but at 2 a.m. on January 30, Taal burst forth with terrific energy, and a roar was heard at a distance of 310 miles. A great black cloud crossed with flashes of lightning and illumined with explosions which may have been of electric origin, but in a globular form, rose from the crater from which two or three times a deep red glow appeared.

FIG. 1.—Crater of Taal Volcano before the eruption (seen from the E.S.E.).

FIG. 2.—Crater of Taal Volcano after the eruption (seen from E.S.E.).

Baragraphs at a distance of 242 kms. were greatly disturbed. An analysis of these showed that a depression had travelled at a rate of 112 miles per hour. This depression appears to have been formed by the inrush of air towards the hot volcanic throat. Between twenty-two and thirty-nine miles from this the fall amounted to 2 mm., or 0·8 inch. The inference is that near the mountain the inrush of air must have had a hurricance force and given rise to a real though short-lived tornado. Round the crater everything was "wiped out" or buried in mud. It was not "destruction," but "annihilation." No lava issued. It was Bandaisan over again, a hurricane or whirlwind had levelled houses, torn up trees or stripped them of their leaves and bark. With it all there may have been a *fiery cloud*, like that which issued from Mount Pelée and destroyed St. Pierre. Two days later Father Masò approached the volcano to find it "very peaceful, with puffs of white vapour succeeding each other at intervals of ten to thirty seconds." Nevertheless, as on that day the Observatory in Manila recorded 130 shocks, Father Masò thought "there was still ground for fearing a fresh outburst." The giant was evidently resting after his angry exertions. May he do so for many years, and when he dies the Philippinos will gladly write R.I.P. above his head.

JOHN MILNE.

THE SOLAR PHYSICS OBSERVATORY.

IN April last a departmental committee was appointed to consider and report upon alternative schemes for transferring the Solar Physics Observatory, now at South Kensington, to Fosterdown (Caterham) or to Cambridge. The report of the committee has just been published as a Parliamentary paper (Cd. 5924).

The committee was composed of Sir Thomas L. Heath, Assistant Secretary of the Treasury (chairman), Mr. F. W. Dyson, F.R.S., Astronomer Royal, Dr. R. T. Glazebrook, C.B., F.R.S., director of the National Physical Laboratory, and Prof. Arthur Schuster, F.R.S., chairman of the executive committee of the International Union for Solar Research, with Mr. F. G. Ogilvie, C.B., as secretary. The terms of reference were:—

To consider the alternative schemes for locating the Solar Physics Observatory at Fosterdown and at Cambridge respectively, and to report which of the two schemes is likely to secure the best results for an annual expenditure of approximately the same amount as is now incurred for the work done under the direction of the Solar Physics Committee.

The conclusions and recommendations of three members of the committee, viz. Sir T. L. Heath, Mr. Dyson, and Prof. Schuster, are as follows:—

We are of opinion that, on a balance of considerations, and especially having regard to the advantage to the progress of solar physics which may be expected to accrue from the establishment and support by the University of a real school combining the studies of solar physics and astrophysics, the Cambridge scheme is calculated to give

the better results for an expenditure of approximately the amount now available for the Solar Physics Observatory.

We recommend, therefore, that the solar physics work be transferred to Cambridge, with an initial grant for buildings and a fixed annual inclusive grant-in-aid to the University, provided that the University will agree to the following conditions :—

(1) That the professor of astrophysics be the director of the Solar Observatory.

(2) That there be a committee or syndicate nominated by the University with functions similar to those of the Board of Visitors of the Royal Observatory at Greenwich.

(3) That the Astronomer Royal and the director of the Meteorological Office be *ex officio* members of the committee or syndicate.

(4) That the University undertake to carry out at the new observatory the necessary amount of routine work on the general lines indicated in paragraph 14 (*b*) and (*c*).

(5) That an annual report, to include a statement of the work done, and an abstract of the accounts of the Solar Observatory showing the application of the grant-in-aid, be presented by the director to the committee or syndicate, to be by them transmitted to the Treasury.

With a view to securing the permanence of any arrangement that may now be made, the committee desire to point out the importance of attaching the directorship of the Solar Observatory, if established at Cambridge, to a professorship which is not merely of a temporary character. The University may not be in a position, at present, to give any definite assurance that the professorship will be renewed at the expiration of the present tenure; but we consider it highly desirable that the Government should ascertain, before coming to a final decision, whether the University is willing at an early opportunity to consider favourably the establishment of a professorship of astrophysics on a permanent foundation.

Dr. Glazebrook dissents from these conclusions and recommendations, and remarks :—

I believe that the evidence placed before the committee and the facts detailed in the report lead to the conclusion that, on a balance of all the considerations, a scheme for locating the observatory at Fosterdown, under conditions similar to those outlined in section 23 of the report, could be arranged at an annual cost of 3000*l.* with a capital outlay of 5000*l.*, and would secure the best results.

The report is of a far-reaching character, and if approved will result in the abolition, and not merely in the transfer, of the Solar Physics Observatory, and the dismissal of its staff.

We believe that it has not yet been referred to the Solar Physics Committee, and that steps are being taken to bring disinterested scientific opinion to bear upon the question. So far as public opinion is concerned, *The Morning Post* and *The Daily Graphic* alone have dealt with the matter. The articles are as follows :—

Examination of the majority report of the committee appointed to inquire into the future of the Solar Physics Observatory at South Kensington must awaken surprise and dismay in the minds of those acquainted with the past history and present working of this institution. Founded forty years ago, when South Kensington was almost a vacant site, it was the pioneer in solar observation; the first observatory to examine the solar prominences; the first to observe sunspots systematically, and the first to attempt to correlate solar and terrestrial phenomena. The lead it gave has been followed by other observatories, and the methods it instituted are those which have been adopted by the Mount Wilson Solar Observatory in California, which is now the chief station for observations of the sun.

When the observations at South Kensington were first undertaken, it was understood that the institution was to be regarded as a Government institution, supported by Government contributions. The grant made was not a large one, though to the observatory and its servants it sufficed to make the work done there known all over the world. But it has remained at the insignificant figure of 3000*l.* a year, on the ground that it was useless to spend money for instruments at an observatory which was being so surrounded by high buildings that its opportunities for observation were yearly becoming more limited. That was reasonable, and the observatory, through its officials—as well as through the Solar Physics Committee, which was formed at Sir Norman Lockyer's initiative to coordinate the work of solar observatories—continually urged the removal of the observatory to a more suitable site. Such a site offered itself at Fosterdown, which is a distant fort on the Surrey Hills, 800 feet above the sea, and which became vacant through the abandonment of the obsolete defences of London. The site had the several advantages desirable and necessary in an observatory: it had a very wide sweep of horizon in all directions; it was removed from the glare of electric lights, from smoke, or vibration. Its concrete floors would have been suited in several instances to the requirements of the foundations of the beds of telescopes.

Fosterdown has, however, been rejected by the majority of the committee in favour of Cambridge, on the ground that at Cabmridge there would be closer association with men of science. The loss of efficiency which will result from giving effect to the decision is signal. Cambridge lies in a flat country, and the observatory is in a river valley. The elevation of the observatory there is 70 feet; it is near enough a road to suffer from vibration. Its night observations are prejudiced by the glare of the Cambridge electric lights; its daylight observations by a town's smoke. If it were only on account of the absence of elevation the site of the observatory would be unsatisfactory. Nearly every great observatory in the world has sought elevation. Paris (Meudon) has gone from 194 feet to 534, Potsdam from 112 to 318. Chicago, the Lick Observatory, Mount Wilson, Flagstaff, Nice, Washington, Madras, Mount Etna, are all at an elevation of 1000 feet or more.

Moreover, the committee themselves admit that Fosterdown is the preferable site, a very inadequate expression of the difference between Cambridge and Fosterdown in view of the evidence that was heard. For the Cambridge site is bound to deteriorate as buildings spring up around it and as the traffic on the road increases, causing vibration. Nor is there any proper provision made for the carrying on of the work. The present professorship is not a salaried post, and it is unlikely that a man of high position will be induced to fill the post as Mr. Newall has done, or that he will be attracted by the meagre emolument of 200*l.* offered in connection with the new post. The committee has apparently neglected the view that the true work of a university is to train and fit men to undertake work. For this Cambridge is already adequately equipped, and this is the legitimate work of a professor rather than the management of an important scientific institution for the conduct of research. As regards Fosterdown, the committee admit that it is probably as good a site as can be found in England.

Nor can the report of the committee be accepted with confidence. From the scientific standpoint the opinion of the Treasury representative can naturally carry no weight. The three other signatories of the report are all men of the highest standing, but they are all old Cambridge men, and without their being in any way conscious of bias, it is not improbable that they may have been unconsciously influenced in their view by their natural loyalty to Alma Mater. Even so, Dr. Glazebrook, who, as president of the National Physics Laboratory, has especial experience in the work of administration, has dissented from his colleagues, advocating the establishment of the observatory at Fosterdown, and recommending that it should be under a director who should give his whole time to the work.

Lastly, quite apart from the material disadvantages of the Cambridge site, there is the far more important one that the removal thither, which would make the Solar Physics Observatory an appanage of an observatory already existing, would imply the dissolution of an institution and the dispersal of a staff which is of international importance and repute.—*The Morning Post.*

In astronomical circles the recommendation of the departmental committee that the old Solar Physics Observatory at South Kensington should be removed to Cambridge has been received with surprise. Economy is the one practical reason for the recommendation; in the words of a well-known astronomer to a representative of

The Daily Graphic, "the choice of Cambridge seems to be because it is cheap."

All the great observatories of the world are moving upwards.

The Paris Observatory at Meudon has removed from 194 feet to 534 feet.

Sicily (Mount Etna), 155 feet to 9735 feet.

Berlin (Potsdam), 112 feet to 318 feet.

Madras (Kodaikánal), 23 feet to 7745 feet.

Vienna, 787 feet to a neighbouring mountain.

Washington (Mount Vernon), 200 feet to 1725 feet.

Chicago Observatory is 1105 feet, the Lick Observatory 4209 feet, Mount Wilson 5712 feet, Flagstaff 7293 feet, Nice 1240 feet.

It has become imperative, in the interests of the accuracy which modern astronomical observation demands, to take the observations well above ground, mist, and fog; and to remove them to sites as distant as possible from the smoke of towns by day and the glare of their lights by night; and their vibration at all times. Not one of these advantages will be derived from the suggested site which the new Solar Physics Observatory would occupy at Cambridge, which lies in a river valley. The observatory would be near a road; there is the smoke of the town, not to speak of the cement works at Cherry Hinton; and there is the glare of the town's electric lights at night. This is easily perceptible five miles away at Little Shelford. Moreover, the height at which the observatory will be stationed is only 70 feet above sea-level. That is perhaps better than the present site at South Kensington, which is only 27 feet above river-level, but not much. The site which was suggested by the Solar Physics Committee was Fosterdown, near Box Hill, in Surrey. That is 800 feet above the sea, and is one of the best sites for astronomical purposes in England. It has wide horizons, no lights near, no traffic, no smoke. Nor is it very dear. The land is Government land, being part of the ground lately occupied by one of the obsolete forts for the defence of London.

More serious, or at least as serious as the rejection of the Fosterdown site in favour of one at Cambridge, is the proposed dissolution of the integrity of the old Solar Physics Observatory, which will henceforward become a mere branch of Cambridge Observatory. It is a very poor reward for services and work done lasting over a generation. The pioneer observation of the South Kensington Observatory is known all over the world, and has been a model for other observatories to follow. One cannot believe that the astronomical world will hear of its dissolution without disappointment and indignation.—*The Daily Graphic.*

NOTES.

REPLYING to Mr. Sandys in the House of Commons on Monday last, Colonel Seely made an important announcement on the subject of military aviation. He stated that the War Office has a progressive policy in the matter, and has hitherto only hung back because it wants to be quite sure, in buying a great number of machines, that they are of the most useful type. The Service now possesses sixteen aëroplanes of eleven different types, of which seven are biplanes and four monoplanes. It is proposed to pay officers who obtain the Aero Club certificate a sum of 75*l.* towards their expenses, and such officers will be attached to the Army Aëroplane Battalion for a course of special instruction, which will include navigation and map-reading. They will then be expected to pass for a certificate similar to the French superior military certificate. The intention is, finally, to provide an efficient service of aërial scouts both for the Navy and for the Army. One hundred officers will be trained immediately as pilots and observers, and non-commissioned officers and other ranks will also be trained. In the discussion that followed, Mr. R. Gwynne asked whether the War Office intends to subsidise experiments, but no answer was given. As comment on the foregoing, it may be interesting to enumerate what machines the Government actually possesses. They are as follows:—*Biplanes:* one original Wright, presented by the late Hon. C. S. Rolls (never flown, and now dismantled); one Howard Wright, purchased from Captain Maitland (broken up); one Paulhan (broken up, capable of repair); one de Havilland (worn out, must be entirely rebuilt); one experimental Voisin Canard type (broken up); one Farman (out of date); one Bréguet; and several Bristols. *Monoplanes:* four Valkyries, presented by Mr. Barber (one broken and two without motors, leaving one effective); one Nieuport; and one Blériot (formerly the property of the late Lieut. Cammell). With regard to the French superior military certificate, the rules for this were issued by General Roques last June, and lay down that military aëroplane pilots must possess the Aero Club (F.A.I.) certificate and the military aviator's certificate. The latter is granted to officers, non-commissioned officers, and men of the regular or of the reserve and territorial army who, possessing the Aero Club certificate, have passed a series of tests to be determined each year in accordance with aëronautical progress. For the present year candidates must have accomplished three closed circuits at a height of at least 300 metres, each circuit comprising a cross-country flight of 50 metres, the landing being made at the starting place. The aëroplane must be of a military type, and carry an overload. Candidates have also to pass an examination on aëroplane motors.

THE notices of aviation feats and fatalities which appear in the daily Press do not often afford the scientific inquirer much indication of any advances in our knowledge of the principles of mechanical flight. The remarkable glide which Mr. Orville Wright performed on October 24 reminds us that there is still much to be done with gliders, and that flight as a sport does not necessitate a costly motor-driven aëroplane. The glide in question, which lasted about ten minutes, was performed at "Kill Devil Hill" in a wind blowing at about fifty miles an hour. By careful manœuvring Mr. Wright caused the wind to pick him up from the top of a sand dune, and in successive gusts he rose 150 feet, finally gliding to the ground. Mr. Wright stated that he had proved that a man can remain in the air without a motor provided there is sufficient wind. The question which naturally suggests itself is how far this feat was due to upward currents caused by the wind blowing up the sides of the dunes. It is one thing to hover round a hill top under such conditions, but it would be a very different task to make use of Langley's "Internal Work of the Wind" in a flight across a bare plain or over the sea.

IN the House of Commons on Monday, October 30, the Home Secretary was asked whether his attention had been directed to the views expressed by Sir William Ramsay in his presidential address to the British Association concerning the exhaustion of the coalfields of this country, and whether the Government anticipated taking any steps tending to the conservation and lessened waste and export of this source of energy supply, having regard to the extent to which the nation's commercial position and the support of the industrial population were dependent on it. In the course of his reply, Mr. McKenna said:—The president's forecast of the probable duration of the coal supplies of the country does not take into consideration certain factors which have an important bearing on the question. In the first place, the estimate took no account of the large amount of coal in fields unproved at the time of the inquiry of the Royal Commission, nor of the amount of coal lying below the depth of 4000 feet which the commission took to be the present limit of workable coal, but which it may be

found possible hereafter to exceed. These two sources the commission estimated at more than 39,000 million and 5000 million tons respectively, or together nearly half as much as the amount of coal estimated to exist in the proved coalfields. In the second place, the estimate was based on the assumption that the output of coal would continue, at any rate for some time, to increase at the same rate as in the past. The commission, on the other hand, considered that at a time not far distant the rate of increase of output would become slower, to be followed by a period of stationary output, and then a gradual decline. The suggestion which Sir William Ramsay is reported to have made, that Parliament should impose a penalty on wasteful expenditure of energy supplies, would involve an amount of control over the industries of the country which, under present conditions, it would be impossible for any Government to undertake. The commission looked forward to the introduction of considerable economies in the future; and I am advised that both in the working and in the using of coal progress is being made in this direction.

M. HENRI MARTIN presented to the Paris Academy of Sciences on October 16 a note on the skeleton of Neanderthal man discovered by him at Quina, in the department of Charente, during September last. This is the fourth find of Neanderthal man which has been made in the south-west of France during the last four years. Former discoveries were made in the valley of the Dordogne, or of its tributary the Vézère, while the present has been made in the valley of a tributary of the Charente, fifty miles further to the north. The stratum of sandy clay in which the skeleton was found is regarded by M. Martin as a former bed of the adjacent stream, and as corresponding in date to the lower strata of the Middle Quaternary deposits. In former discoveries of this nature there was evidence that the remains had been buried or been naturally entombed, but in the present case the evidence points to the remains having been embedded during the formation of the deposit in which it was found. In the same stratum were found flint and bone implements, which M. Martin ascribes to the older Mousterian civilisation. The teeth are very similar in character to those found recently in a cave in Jersey, and described in the current issue of *The Journal of Anatomy and Physiology* by Messrs. Keith and Knowles. The skull, which has become broken along the sutural lines, is said to show the well-known characters of the Neanderthal race in a very pronounced degree. The remains of the skeleton have been transported to Paris still embedded in the blocks of loam in which they were discovered, and will ultimately be added to the collection in the Muséum d'Histoire naturelle.

AGRICULTURISTS will regret to learn that M. Gaston Gautier recently died at Narbonne, at seventy years of age. M. Gautier, who was brother of M. Armand Gautier, president of the Academy of Sciences, was a member of the Société de botanique de France, and had published several botanical memoirs. But his great claim to fame is that he introduced the culture of the vine into a region that had been little better than a huge pestilential swamp round Narbonne. The first efforts at reclamation were made on his own estate of Craboules, and finally met with such success that many of his neighbours followed his example; by degrees the swamp gave way to fruitful vineyards.

THE death is announced, at ninety years of age, of Mr. John C. Fuller, whose name is familiar to electricians in connection with the Fuller bichromate battery. A correspondent of *The Times* points out that Mr. Fuller was at one time an assistant of Faraday. He joined the Electrical and International Telegraph Company in 1854, and during his connection with it worked with Latimer Clark and Sir William Preece. One of the results of Mr. Fuller's early studies was the invention of the universal battery system, by which one set of cells works a whole group of circuits. He invented several other forms of battery. About 1857 he assisted Messrs. Silver and Co. (the founders of the India-rubber, Guttapercha, and Telegraph Works Company) in applying indiarubber to telegraph purposes. Here he designed the machines and methods for covering wire and made vulcanite insulators. Later, before founding his own firm, Messrs. John C. Fuller and Son, he assisted Mr. W. T. Henley, the submarine cable manufacturer. At this time he invented and patented the mercury bichromate battery.

IT is with deep regret that we learn of the premature death, at fifty-four years of age, of Prof. Alfred Binet. Prof. Binet was director of the laboratory of physiological psychology at the Sorbonne, and was very well known among psychologists—above all as an ardent investigator of the first rank into problems of child psychology. He founded "L'Année Psychologique" in 1897, in which appeared, year by year, highly important articles from his own pen. Among many well-known books of his upon psychological topics may be especially mentioned "L'Étude Expérimentale de l'Intelligence," "La Suggestibilité," "L'Âme et le Corps," and "Les Idées modernes sur les Enfants" (his latest publication). The science of psychology has suffered a severe loss in his death.

THE annual Huxley memorial lecture of the Royal Anthropological Institute will be delivered on Thursday, November 23, in the theatre of the Civil Service Commission, Burlington Gardens, S.W., by Prof. F. von Luschan, whose address will be on "The Early Inhabitants of Western Asia." Mr. Alfred P. Maudslay, president of the institute, will occupy the chair.

THE council of the Institution of Civil Engineers has made the following awards in respect of papers published in Section ii. of the Proceedings for the session 1910–11:—Telford premiums to Messrs. S. M. Dixon, H. J. F. Gourley, J. Holden, A. Rogers, A. E. Griffin, Dr. F. C. Lea; and a Crampton prize to Prof. W. E. Dalby. The Indian premium for 1911 has been awarded to Mr. C. E. Capito, and the Webb prize to Mr. F. W. Bach.

THE list of lectures to be given on Mondays and Thursdays during the present session at the London Institution, Finsbury Circus, London, E.C., has been circulated. Among the numerous subjects of interest to be dealt with in the lectures we notice the origin of life question, by Dr. H. C. Bastian, F.R.S.; life on the high mountains of Mexico, by Dr. H. F. Gadow, F.R.S.; man under the microscope, by Dr. Alex. Hill; storm rains, by Dr. H. R. Mill; alchemy, by Mr. M. M. Pattison Muir; and waves of the sea, by Dr. Vaughan Cornish.

AT the meeting of the London Section of the Society of Chemical Industry, to be held on Monday, November 6, at Burlington House, Dr. E. G. Acheson, of New York, will read a paper on deflocculation as affecting lubrication. Dr. Acheson is well known as the inventor of lubricants consisting of deflocculated graphite—"Aquadag" and "Oildag" of carborundum, &c. The paper should be of interest to all who are concerned with lubrication and lubricants. Dr. Acheson will also give an address to the Faraday Society on Wednesday, November 8. Non-members of the society will be admitted by ticket, to be

obtained upon application to the Secretary, 82 Victoria Street, S.W.

The council of the Royal Institute of Public Health has accepted an invitation from the Chief Burgomaster of Berlin to hold the congress next year in that city on July 25–28. The congress will include the following sections and presidents:—State medicine, Sir T. Clifford Allbutt, K.C.B., F.R.S.; bacteriology and comparative pathology, Prof. G. Sims Woodhead; child study and school hygiene, Sir James Crichton-Browne, F.R.S.; military, colonial, and naval, Major Sir Ronald Ross, K.C.B., F.R.S.; and municipal engineering, architecture, and town planning, Mr. P. C. Cowan. Facilities will be afforded for visiting the various public health and educational institutions in Berlin in connection with the Imperial Board of Health, the Municipality, and the University.

In connection with the 200th anniversary of the foundation of the Spalding Gentlemen's Society, in 1709, the society has recently built a home for its library and museum, which also includes a magnificent lecture theatre, committee rooms, &c. The new building was opened on October 25 by Sir Henry H. Howorth, K.C.I.E., F.R.S., who referred to the extraordinary fact that a society should have carried on its work for two centuries and should then be in a position to purchase a building for its treasures. In the evening there was a public lecture on "The Romans in Lincolnshire," by Mr. T. Sheppard, in which he described many thousand relics of the Roman period, now in the museum at Hull, from a little-known site on the north Lincolnshire coast. Sir Harry Howorth occupied the chair. During the day Mr. Sheppard also gave an address on the use and value of local museums.

In *The Quarterly Review* for October M. Salomon Reinach reviews the present condition and progress of mythological study. He shows how the earlier explanations of myths suggested by writers like Fontenelle, De Brosses, David Hume, and Dupuis gave way before the researches of Grimm and Mannhardt, to be succeeded by the theories of Kuhn and Max Müller. These last, in their turn, were superseded by the anthropological school, under the leadership of "that wittiest of scholars and most scholarly of wits," Mr. Andrew Lang. This revolt against the philologists was largely due to the advance in the knowledge of philology, which no longer accepts the identifications of the names of many Greek and Roman deities with those of India advanced by Max Müller himself and extended by his more ardent followers, like De Gubernatis and Sir G. Cox. It was also the result of the colonial policy of England which tended to extend the horizon of research from Aryan gods to the mythologies of savage races. The methods of the anthropological school were still further extended by W. Robertson Smith and J. G. Frazer. But the views of these last authorities are already disputed by the psychologists and sociologists. M. Reinach closes his instructive survey of the situation by the remark that "underlying and stimulating the work of criticism, as applied to the chief results of the anthropological school, I see, at all events in my own country, the ever-active upholders of tradition and established creeds."

At a meeting held in Norwich on October 26, 1908, a society was established for the study of prehistoric archæology, especially with reference to the eastern counties, and shortly afterwards it adopted the title of "The Prehistoric Society of East Anglia." We have lately received the first part of its Proceedings, an octavo of 121 pages, containing a report of the work of the first two sessions, with several original papers printed in full. In a communication on the flint implements of sub-crag man, Mr. J. Reid Moir describes his well-known discovery of flints, reputed to have been worked by man, in deposits that, in some cases, are admitted by distinguished geologists to be undisturbed Red Crag. Dr. W. Allen Sturge, M.V.O., the first president of the society, contributes not only an appropriate inaugural address, but also a rather voluminous paper on the chronology of the Stone age. Although the views expressed in this paper are based to a large extent on the study of his extensive collection at Icklingham Hall, in Suffolk, as well as on local field-work, they are likely to evoke no little opposition, both from the geological and the archæological sides. The superficial scratches on many worked flints of Neolithic age he refers to glacial action, and thence concludes that an ice period, with several phases, must have occurred in Britain since the incoming of Neolithic man. Similar evidence in the case of certain palæoliths is accepted as proof of at least one Glacial period during Palæolithic times. Dr. Sturge ventures to suggest that the Neolithic age may have begun about 300,000 years ago, and the Palæolithic perhaps a million years ago. In forming these startling conclusions, he relies on Croll's hypothesis, which, although abandoned by most geologists, he does not admit to have been yet disproved.

Naturen for October contains an article by Prof. A. W. Brogger on prehistoric stone implements, the rock-shelters where some of them were found, and the remains of mammals and birds by which they were accompanied.

According to the report of the New Zealand Scenery Preservation Board for 1910–11, a total of 25,442 acres was reserved during the year under review, this bringing up the total of the reserved areas to 65,989 acres. It is pointed out "that by virtue of past legislation all scenic reserves and national parks in New Zealand are practically sanctuaries for the native birds and game, and no shooting or killing whatever is permitted on them. The greatest care is taken to keep them free from noxious weeds, and wherever practicable and advisable the fencing of the external boundaries has been proceeded with, particularly when the reserve adjoins settled land or a road in general use."

In *Himmel und Erde* for October (Jahrg. 24, Heft 1) M. Ficker contributes the first of a series of popular articles on the bacteria as the friends and foes of man. After a brief historical introduction, the classification and structure of the bacteria are considered, with illustrative figures.

A Bulletin (No. 146) has been issued by the Agricultural Experiment Station of the Rhode Island State College, U.S.A., on the cholera-like diseases occurring among poultry. It is shown that, in addition to the well-known micro-organism of chicken cholera, first studied by Pasteur and Toussaint, several other microbes cause similar diseases among poultry, some of which possess extreme power of infecting.

Botanists engaged in systematic work, or interested therein, will find in the catalogue No. 22, "Botanica Geographica," issued by Messrs. Dulau and Co., Soho Square, London, an extensive assortment of second-hand literature offered for sale. The items are most numerous under the sections devoted to Europe and North America; contributions to the botany of Africa are also well represented.

A second contribution to their studies of Indian fibre plants, prepared conjointly by Mr. and Mrs. A. Howard,

deals with *Hibiscus cannabinus*, popularly known as Deccan or ambari hemp, and *H. Sabdariffa*, the Rozelle plant; it is published in the Memoirs of the Department of Agriculture in India as vol. iv., No. 2, of the botanical series. The investigation was primarily directed towards analysing the ordinary crops with the view of eliminating cross-fertilisation and securing uniformity of product. Five varieties, showing differences in the seedling and early vegetative stages, were isolated; descriptions of these and coloured figures are supplied. Two of the types are regarded as specially promising, and it is intended to develop these by pure-line cultures. The account of *H. Sabdariffa* is confined to comparative notes on pollination and the descriptions of four varieties.

THE interesting chapter on the history of fossil botany, chosen by Dr. D. H. Scott as the subject of his presidential address to the Linnean Society at the close of the last session, dates back three-quarters of a century, to a time when Witham in England and Cotta in Germany were prominent investigators, and the more illustrious Brongniart was engaged upon his earlier researches. Morphological elucidation was the guiding principle of Brongniart's studies, and in most cases he found it necessary to discover the required morphological data himself. His "Histoire des Végétaux Fossiles" contains in the introduction a definite recognition of four successive geological periods characterised by different types of vegetation. Witham's chief service was to demonstrate the early prevalence of gymnosperms, and he was also the first to describe the structure of the historic fossil *Lepidodendron Harcourtii*, although it remained for Brongniart to identify the ring of wood. To Cotta credit is due for the foundation of the genus Medullosa, and a virtual recognition of its polystelic character.

IN the *Naturwissenschaftliche Wochenschrift* for October 1 there is an article on the geological study of earthquakes, by Dr. Erwin Scheu, whose name is well known in connection with catalogues published by the International Association at Strassburg. The article deals with macroseisms, or earthquakes which can be felt. The intensities of these should be referred to a scale; but as seismologists are already troubled with sixteen different scales of intensity, it is not clear why Dr. Scheu should add to their number. He, however, suggests one which, he remarks, might be suitable for Europe, but hardly suitable for the tropics. An earthquake which is not felt should, according to the new scale, be indicated by the numeral I, whilst one accompanied by complete destruction, which refers to a megaseism rather than a micro- or macroseism, has an intensity of VII. In a map of isoseists for the earthquake of Jókeö, January, 1906, some of them are, however, marked VIII and IX. In connection with the construction of isoseists, we are told that the intensity of movement exhibited in hard rocks like granite is greater than it is in materials like marl and clay. So far as destructivity is concerned, our impression has been that this is generally the reverse. The influence of fault lines, as, for example, those in the Rhine Valley and mountain ranges, upon the distance to which earthquake motion may be propagated is pointed out. Illustrations are given of the destruction caused to buildings, and the displacements, vertical and otherwise, of land surfaces. Dr. Scheu's article is distinctly popular, and as such suggests phenomena to be observed at the time and after the occurrence of an earthquake.

THE meteorological charts of the North Atlantic and Mediterranean for November, issued by authority of the Meteorological Committee, contain an instructive account of the behaviour of a heavy storm in the North Sea, illustrated by synoptic charts. Between September 28 and 29 a small cyclonic system seems to have formed near 50° N. and 30° W.; on the morning of September 29 the chart for that day shows that the centre was about 57° N. and 25° W., and was advancing towards the coast of Ireland, increasing in velocity and intensity as it travelled eastwards. On the morning of September 30 the centre was near Spurn Head; during the gale an extreme force of 10 (Beaufort scale) was recorded at several stations on the East Coast, and at 6h. p.m. the centre passed over the north of Holland. An interesting point in this storm is that apparently the wind force experienced by vessels in the North Sea was greater than that at many of the land stations in telegraphic communication with the Meteorological Office. The numerous casualties to shipping would also seem to show that the high seas must have been exceptional.

IN *Symons's Meteorological Magazine* for October Mr. W. Sedgwick continues his interesting notes on the weather in the seventeenth century: part iii., autumn (see NATURE, June 1). He points out that at this season of the year such phenomena as heat waves, severe frosts, &c., are not likely to occur, at any rate near London. It is not surprising, therefore, that Evelyn and Pepys made fewer comments than in the case of the other seasons. To those who still firmly believe that the climate of England has changed, the month of October presents special interest, owing to the comparatively high temperatures experienced in that month in recent years. In a paper read before the Royal Meteorological Society on April 19, on variations in English climate, it was shown that for the last fourteen years (1897–1910), except only in 1905, the temperature was above the average in October. So far as can be judged from the chronicles above referred to, this variation in recent years is merely a periodic change, as they do not show that the weather of that month was noticeably colder than at the present time. Frequent references are made to the pleasant weather experienced; only one October (1692) was referred to as a cold month; Pepys described that of 1668 as "the most summer weather that was ever seen." The general character of the weather in November also, as described by Evelyn, was very similar to that of the present time.

IN a paper by Prof. Henry Louis on the mutual developments of metallurgy and engineering, read before the University of Durham Philosophical Society, and published recently in its Proceedings, much interesting information is given about the history of metallurgical processes. It seems to be fully proved that the Assyrians were not only well acquainted with iron, but had attained some considerable skill in its manufacture, having advanced far enough to make chain mail; thus, so far back as 900 B.C., iron manufacture had long passed the rudimentary stages. The only other common metals known to the ancients were lead, copper, and tin, all of which are easily reduced from their ores; brass was known for a very long time before it was discovered that zinc was one of its constituents, it being always made direct from zinc ore; Roman brass coins have been analysed, and found to contain more than 25 per cent. of zinc, so that the material was certainly known to them, although they did not know its true composition. The metallurgy of lead was relatively far advanced; quite a number of pieces of lead of Roman age have been found in this country, the earliest date about 44 A.D., and several of these are marked "EX. ARG.," or desilverised; it is also evident from the composition of articles of Roman lead that the metallurgists of that day

were tolerably well advanced with their methods of desilverisation.

The Electrical Review for October 13 discusses in a leading article the question as to whether there is or is not at the present time a demand for technical men in the electrical engineering profession. After reviewing the evidence afforded by recent letters to the Press, it concludes that the overcrowding of which there have been complaints is confined to the lower branches, and that it is due to the large class of men who have had no technical training. While the general impression that the profession was overcrowded has led to a decrease in the entries of students in the electrical engineering colleges, a decrease which has now gone on for several years, there is to-day, as a matter of fact, a greater demand for technically trained men than the colleges can supply.

IN order to clear up the small differences which still exist in the determinations of the melting points of metals like zinc and cadmium by even the most accurate observers, Drs. Holborn and Henning, of the Reichsanstalt, have compared together a number of platinum thermometers and two constant-volume gas thermometers of Jena glass 59 III., and of quartz glass filled in turn with nitrogen, hydrogen, and helium. Both the Jena and the quartz glass were slightly porous to the helium above 200° C., but the former showed no signs of being permeable to hydrogen up to 450° C. The constant δ of the platinum thermometers lay between 1·486 and 1·510, but in no case did the temperature between 200° and 450° C. determined by the platinum thermometers with the use of the δ formula differ by 0·1° C. from the temperature given by the gas thermometers. The following melting and boiling points were obtained:—tin, 231·8°; cadmium, 320·9°; zinc, 419·4°; naphthalene, 217·96°; benzophenone, 305·89°, on the thermodynamic scale.

FURS which are moth-proof owing to the substitution of indiarubber for animal tissues would seem at first sight to be a fantastic stretch of the imagination only. A curious invention recently recorded, however, would appear to render rubber-backed fur a possible and practical article of the near future. Large skins, or small pelts sewn together, are stretched upon a frame with the fur uppermost in a large flat-bottomed receptacle, which is then filled with water and placed in a freezing chamber. The plate of ice is then removed, and with suitable machinery a thin layer is sawn from the bottom, thus removing the skin, which after thawing is sold for the purposes of leather. The lower surface of the remaining plate is then melted until the fur is slightly exposed, when a coating of rubber solution is applied layer by layer. When the requisite thickness is obtained the rest of the plate containing the fur is melted, and a large seamless pelt, with a sheet of rubber at its base, is the result. Cheapness is one of the many advantages claimed by the inventor. Ladies with valuable furs, which annually cost a considerable sum for cold storage, will wish every success for so ingenious an invention.

SOME interesting observations regarding the formation of hydrocyanic acid during the germination of seeds are contained in a paper by C. Ravenna and M. Zamorani in the *Gazzetta Chimica Italiana* for September 19 (vol. xli., ii., p. 74). The old experiments of Jorissen and the more recent ones of Soave have shown that some seeds, such as sweet almonds and the seeds of *Mespilus japonica*, form considerable quantities of hydrogen cyanide at the beginning of active life. On the other hand, the experiments of Guignard with *Phaseolus lunatus* point to a destruction of hydrocyanic acid at the commencement of germination, especially in the case of etiolated plants. The experiments now described were made on two species of seed, viz. *Sorghum vulgare*, which does not contain appreciable traces of hydrogen cyanide, and a variety of linseed, which contained it in considerable proportion. In the case of the former, hydrogen cyanide was elaborated during germination up to a certain point, beyond which it appeared to undergo progressive destruction; in the latter case a continuous increase of hydrogen cyanide was observed without a point of decomposition being attained. In all cases the rate of production of the cyanide was greater in the green than in the etiolated plants; but on watering the latter with a 2 per cent. solution of glucose during growth, the proportion of hydrogen cyanide formed was increased up to the level of the green plants. The amount of carbohydrates in the seed thus greatly affects the formation of the hydrocyanic acid. The source of the nitrogen remains to be investigated.

THE council of the Institute of Chemistry has inaugurated a series of lectures, the first of which was delivered by Mr. Bertram Blount at King's College on October 26. The chair was taken by Prof. J. Millar Thomson, F.R.S., who said the lectures were an extension of the work of the institute on lines directed to benefit advanced students of chemistry. Except for one or two lectures delivered in its early history, the institute has not assumed in any way the functions of a teaching body, though the charter provides for such functions. Mr. Blount limited his remarks to calcareous cements, and more particularly to the Portland cement industry. Calcareous cements, properly so called, while being plastic, are capable of hardening and are resistant to water. The common fallacy, that the setting of lime mortar is due to the action of lime on the sand with which it is mixed, was once more exploded. Some siliceous materials have an advantage over others as aggregates for mortar. These are known generally as "pozzolanas," and their usefulness depends on the hydrated silica or attackable silicates they contain, which interact with lime and form compounds resistant to the action of water. There seems to be no record that limestones were intelligently chosen for the hydraulic quality of the lime which they furnished until the time of Smeaton, who, in considering with what material he should build the Eddystone Lighthouse, ascertained that Aberthaw limestone was undoubtedly hydraulic. Those limestones which are most hydraulic contain the largest proportion of argillaceous material. This quality may be improved by the addition of what is capable of conferring hydraulic properties on ordinary lime. Mr. Blount also discussed the manufacture of so-called "Roman cement," a crude form of Portland cement made by burning lumps of clayey limestone. Starting with the notion of imitating Roman cement, the progenitors of the Portland cement industry arrived at the idea that when chalk and clay were mixed and burned an hydraulic material was produced which, when ground, would set and form a strong, sound cement.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR NOVEMBER:—

Nov. 6. 3h. 37m. Moon eclipsed, partly visible at Greenwich.
,, 12h. 11m. Saturn in conjunction with the Moon (Saturn 4° 18′ S.).
7. 7h. 19m. Mercury in conjunction with Jupiter (Mercury 1° 50′ S.).
,, 20h. 50m. Mars in conjunction with the Moon (Mars 2° 53′ S.).
9. 18h. 0m. Saturn at opposition to the Sun.
10. 21h. 31m. Neptune in conjunction with the Moon (Neptune 5° 52′ S.).

11. 13h. 0m. Ceres in conjunction with the Moon (Ceres 0° 48′ S.).
16. 6h. 58m. Venus in conjunction with the Moon (Venus 1° 13′ S.).
18. 4h. 0m. Jupiter in conjunction with the Sun.
21. 20h. 24m. Mercury in conjunction with the Moon (Mercury 1° 28′ N.).
24. 17h. 0m. Mars at opposition to the Sun.
25. 5h. 41m. Uranus in conjunction with the Moon (Uranus 4° 44′ N.).
,, 20h. 0m. Venus at greatest elongation W. of the Sun.

OBSERVATIONS OF COMETS.—It appears from a note by Mr. Knox Shaw, in No. 4531 of the *Astronomische Nachrichten*, that the discovery of Borrelly's comet, 1911*e* (1905 II.), was made with the Reynolds reflector, but was a visual observation, photographs being secured later; the comet's magnitude on September 19 was 13·0 to 13·5, and there was no marked nucleus.

Messrs. Innes and Wood describe the Johannesburg observations of comets 1911*b* (Kiess) and 1911*d* (Encke) during August and September, and Mr. Innes compares the reduced places of Encke's comet with the positions given in Dr. Backlund's ephemeris. The smoothed O–C difference in R.A. increases from 28·3s. on September 3 to +47·3s. on September 14, the corresponding figures for declination being −4·7′ and −6·2′ respectively. The magnitude of the comet early in September was 9·5, and the photographs were taken by Mr. Wood, with the Franklin-Adams star camera, in exceedingly difficult circumstances. Kiess's comet was of about fifth magnitude, and showed no tail on August 17, and then rapidly faded to mag. 11·5 on September 17.

Brooks's Comet (1911*c*), October 27, 4h. 45m. a.m.

Brooks's comet, 1911*c*, has been quite a conspicuous feature of our early morning skies during the past week. A naked-eye observation by Mr. Rolston at Gunnersbury on October 27 showed a straight tail some 15° long, at times seen to extend to 93 Leonis. The head was a little less conspicuous than δ, but brighter than θ, Leonis; thus its magnitude would be about 3·0. As is shown in the accompanying illustration, the comet, at 4h. 45m. a.m., formed a striking triangle with β Leonis and the very brilliant Venus. At 5 a.m. on October 31 a tail some 12° long was seen, and at times a further extension was suspected. The head, seen through opera-glasses of low power, had the appearance of a fairly bright homogeneous disc; to the naked eye it was no less conspicuous than γ Virginis (mag. 2·8).

CHANGES ON MARS.—M. Jarry-Desloges, in a communication to the *Astronomische Nachrichten*, No. 4531, states that there is a bright area on the Mare Tyrrhenum similar to that already noted on Libya, and that the regions of Hesperia and Ausonia are completely modified since October 12. This message is dated October 15 from the new observatory at Sétif, North Africa. In the same journal there is a paragraph stating that observations have been carried on at this station since the end of September; its position is long. = 3° 4′ 21″ E. of Paris, lat. = 36° 11′ 19″ N., and it is situated at 1113 m. (3650 feet). At such an altitude the air is quite clear and suitable for astronomical observations, and M. Jarry-Desloges hopes to be permitted to confirm observations of the Martian surface made at other observatories. To this end he asks for early and brief communication of the detection of any remarkable phenomena; the address for letters is: Astronome de Service à l'Observatoire Jarry-Desloges, Sétif, Algeria; and for telegrams: Observatoire Sétif, Algeria.

COLOUR PHOTOGRAPHS OF SATURN.—Having secured the colour photographs of Mars recently described in these columns (October 19), M. Tikhoff turned his attention to a similar study of Saturn. It had been remarked, some years ago, by M. Belopolsky that the spectrum of the rings of Saturn appeared to extend further into the ultra-violet than did the spectrum of the disc, and this suggested the use of colour screens. With screens prepared by M. Tikhoff, M. Belopolsky therefore employed the 30-inch refractor in 1909 and during the earlier months of the present year to secure colour photographs of the planet. Two parts of the spectrum were used, the "indigo-violet" (390–450 $\mu\mu$) and the "yellow-green" (495–620 $\mu\mu$). M. Tikhoff examined the plates, and arrived at the following general conclusions. Passing from red to violet, the difference in intensity of the edges and centre of the ball diminishes, and finally disappears; the equatorial band is most brilliant in the red and darkest in the violet. The behaviour of the rings is directly opposite to that of the ball, but the edges of the disc and the contiguous parts of the rings are equally intense in all radiations. Observations of the spectra of the various parts confirm these conclusions, which may be explained by the presence of an atmosphere about the disc and none about the rings. It would also appear, from their similarity of transmission, that the particles forming the rings and those forming the atmosphere about the disc are of similar magnitude; that is to say, the pulverulent particles of which the rings are built up have diameters which, in the mean, are less than wave-lengths of light.

AURORÆ IN MIDDLE LATITUDES.—Referring to Sir Lauder Brunton's letter describing a pseudo-aurora seen at St. Beatenburg, Switzerland, Dr. Krebs sends us a card saying that he too saw flashes of light in the north, as seen from Grossflotbek, at 9h. 10m. (G.M.T.) on August 21. The sky was then nearly three-parts covered with cloud, and thunderstorms prevailed about that period. As a possible explanation of the phenomenon he refers us to an article by himself in *Urania*, No. 9 (February 26, 1910), where he describes a light which he saw off Nantucket on May 15, 1909, which was seen from Blue Hill at a corresponding time. As seen by him it was in the N.E.–N.W. region, but seen from Blue Hill it was south of the E.–W. line; thus it lay between the two stations, between lat. 40·5 N. and 42° N. Perturbations of the compass accompanied the apparition, and it is suggested that a charged cloud capable of giving these and emitting the flashes of light passed somewhere between the two stations.

THE MINOR PLANET 1911 M.T.—Dr. Palisa's description of how he found the new and important minor planet 1911 M.T. is given in No. 4530 of the *Astronomische Nachrichten*. He first drew it on his chart on September 29, but found its position empty on October 3. When seen on this date the object appeared to present a nebulous appearance, suggesting the possibility of its being a comet, but a further observation on October 4 negatived this.

GEOLOGICAL WORK IN THE UNITED STATES.

THE papers dealt with under this heading are merely representative of a large amount of literature devoted to the understanding of the ground on which the United States have become founded. Whether from an educational or from a more economic point of view, this wide territory continues to be actively explored, and the existence of State surveys, side by side with that centred in Washington, testifies to the value set upon geological research. The thirtieth and thirty-first annual reports of the U.S. Geological Survey, issued by the director, G. Otis Smith, in 1909 and 1910, show how the survey has often preceded its topographers in the field. These reports now indicate the main features of administration and publication during a fiscal year, the scientific papers being wisely issued in a separate form. J. M. Nickles supplies bibliographies of North American geology for 1908 and 1909 (Bulletins 409 and 444), with useful subject-indexes.

As a sample of the present convenient form in which the Geologic Atlas is obtainable, we may mention folio 169, the Watkins Glen-Catatonk Folio, by H. S. Williams, R. S. Tarr, and E. M. Kindle. In the "field edition," with its low price of 25 cents, the maps are folded into a pocket in the octavio memoir, which supplies an illustrated description of the district, occupying 242 pages. Two topographic contoured maps are given, and are followed by two showing "areal geology" and two showing "surficial geology," printed in colours over the topographic groundwork. The district, lying in the Allegheny Plateau, between Lake Ontario and the Pennsylvanian border, furnishes R. S. Tarr with a good field for glacial investigation. He traces two epochs of ice-advance, the first being especially accompanied by overdeepening of the valleys.

S. R. Capps describes, in Bulletin 386, the "Pleistocene Geology of the Leadville Quadrangle, Colorado." Here, again, considerable overdeepening and widening of valleys has occurred (p. 12), and the country includes typical topographic features due to glacial erosion and deposition (Fig. 1). W. M. Davis has already examined some of these, and his influence may be felt in the explanatory passages with which the present memoir introduces us to the district. The bulletin is eminently one for scientific students who may travel in central Colorado. W. R. Calvert describes (Bulletin 390) the Lower Cretaceous coal-bearing strata of Lewistown, Montana, in a district where Carboniferous and Jurassic beds are also represented. P. S. Smith (Bulletin 433), in the Seward Peninsula of Alaska, has encountered (p. 97) the phenomena of soil-cap movement that have been somewhat grandiloquently styled "solifluction" by Swedish authors. He describes independently how the frozen earth receives a burden of detritus, and how this burden flows downhill when the ice below it begins to melt. Materials from various levels of the hills thus become mixed, to the annoyance of the prospector, who seeks his gold in the stream gravels that are liable to be covered by an "earth run." Vegetation flourishes in places on soils laid down, by streams or by earth-sliding, on beds of ice, which originated in ancient snowfalls. The maps in this bulletin show well the auriferous gravels, and the uplifted coastal plain on Norton Sound. In Bulletin 435, N. H. Darton records "a reconnaissance of parts of north-western New Mexico and northern Arizona," and illustrates once more the famous cañon country. The problem of the sandstone crater of Coon Butte (p. 72), which is 3900 feet in diameter and 600 feet deep, is believed to be best met on the volcanic hypothesis of a steam-explosion.

N. H. Darton has also studied the geology and water resources of the Black Hills region in S. Dakota and Wyoming (Professional Paper 65), in continuation of his report of 1901. This district includes, among other bold buttes left by erosion on the plateaus, the remarkable columnar mass known as the Devil's Tower (Fig. 2), which the author believes to be connected with an underlying vent. The nature of the "igneous rock" is not stated.

Professional Paper 72, by L. C. Glenn, on "Denudation and Erosion in the Southern Appalachian Region," includes a useful essay on erosion for the non-geological reader, with illustrations from areas under vegetation and those from which grass and forests have disappeared. The disastrous effects of sulphuric acid fumes from smelting furnaces are shown in views near Ducktown, Tennessee (Plate xvii.). The paper is thus of interest for geographers, and includes photographs of stream-meanders and river-flood phenomena.

Palæontology is represented by several bulletins. E. M. Kindle (No. 391) treats of the Devonian fauna of the Ouray Limestone in Colorado. The upper part of this limestone is marked off by its fossils as Mississippian (L. Carboniferous). Several new species and a new genus of Brachiopods (Syringospira) are described. R. Arnold (No. 396) writes on the "Palæontology of the Coalinga District, California," where strata from the Franciscan (Jurassic?) series up to freshwater Pliocene beds are represented. The eight unconformities indicate the instability of this western region. G. H. Girty describes (No. 436) the fauna of the Phosphate Beds of the Park City formation in Idaho, Wyoming, and Utah, and points out the existence of a specialised type of Carboniferous fauna widely distributed through the west (p. 10). Brachiopods are scarce, and molluscs are unusually common. G. H. Girty has also (No. 439) reported on the "Fauna of the Moorefield Shale of Arkansas," a Mississippian zone which he allies with the Caney Shale of Oklahoma.

FIG. 1.—Spur truncated by glacial erosion, near Crystal Lake, south-west of Leadville, Colorado.

Economic geology is properly dominant in other bulletins. T. N. Dale (No. 404) writes on the granites of Vermont, with illustrations of their utility in the arts. F. L. Ransome, W. H. Emmons, and G. H. Garrey collaborate in a report (No. 407) on the "Geology and Ore Deposits of Bullfrog District, Nevada," an arid region where gold, derived from pyrite, occurs in a series of oxidised ores. Crystalline schists have been developed from Ordovician or

older sediments by pressure and by the intrusion of pegmatite along the planes of foliation (p. 27). Rhyolites form stratified masses on the surface, and contain spherulites (p. 39) up to 4 feet in diameter. These and the desert scenery are well illustrated. Bulletin 417, by F. H. Moffit and A. Knopf, on "The Mineral Resources of the Nabesna-White River District, Alaska," is mainly concerned with the geology, and contains pictures of the piedmont glaciers. Bulletin 420 deals with "The Feldspar Deposits of the United States," and is a practical introduction to the industrial use of pegmatites. T. L. Watson (No. 426) describes, with adequate illustration, the granites of the south-eastern States. The orbicular gabbro-diorite illustrated on p. 145 is proposed for ornamental purposes. The papers on water-resources show, as usual, a close alliance between the work of the Survey and the living interests of the people.

We may mention here a paper issued by the U.S. Department of Agriculture in 1911, by W. H. Waggaman, on the phosphate fields of Florida, in which it is estimated that the deposits of detrital pebbly phosphate, probably of Pliocene age, are "almost inexhaustible." For all that, we may well fear the energy of the modern agriculturist.

FIG. 2.—The Devil's Tower, south of Hulett, Wyoming.

The United States Survey (Bulletin 465) has supplied us with a history of the various Geological Surveys organised by separate States, and we may now mention some recent publications of these bodies. Maryland has issued vols. vii. and viii. of her handsome cloth-bound series. Great attention has been given to road-metal, for roads have now a new meaning in the wealthier States. It is to be regretted that the only way of preserving certain roads in Maryland from the destruction due to uncontrolled motor-traffic is the formation of depressions across them, which check any attempt at furious driving. As in our own islands, legislation is regarded as powerless to remedy the evil. Vol. vii. is concerned with a topographical re-survey of the boundary between Maryland and Pennsylvania, first marked out in 1763.

Wisconsin supports a joint Geological and Natural History Survey, and has recently issued several maps of the lead and zinc mining district, on the large scale of 4 inches to the mile, with contour-lines at intervals of 10 feet.

The annual report of the Iowa Geological Survey for 1909 (received in 1911) contains much matter of interest to the glacialist. The papers written by the geologists, and notably that on Hamilton and Wright counties, by T. H. Macbride, are addressed to any intelligent citizen. They cannot fail to arouse interest in the features that diversify the great flat lands of this central State, nearly four-fifths of which are occupied by prairies. The State is being described county by county, and B. Shimek, in Harrison and Monona counties, illustrates the loess deposits, which often form conspicuous bluffs. Land-shells form the immense majority of the molluscan fossils of these beds, and the author strongly supports (p. 399) the æolian view of their accumulation. The survey of these two counties has led to the discovery (p. 309) of a rich mammalian fauna in the Aftonian interglacial stage, including elephants, horses, and Mylodon. The freshwater molluscs of the same beds are mostly still living in West Lake, Okobozi, Iowa. The botanical report (pp. 426–483) on the prairie flora and its conditions of growth will interest students of plant-distribution. The huge granite boulders of the earlier or Kansan drift, illustrated by M. F. Arey in Plate xi., remind us of those of the North German plain, and the intelligent citizen before mentioned may like to learn more as to how they came into the ice-sheet.

Bulletins 1 and 2 of the Colorado Geological Survey, published in one volume, bound in cloth, describe two mining districts, with the aid of coloured maps.

The Colorado School of Mines issues a "Quarterly," reviewing the mining progress of the State, and geological papers may also be found in the "Studies" published at Boulder by the University of Colorado. J. Henderson writes in the latter (vol. viii., 1910–11, p. 33) on "Extinct and Existing Glaciers of Colorado," with good illustrations and a general introduction to the subject. The glaciers are, of course, interesting on account of their small size and evidences of retreat.

Among papers that have reached us from private sources, we may mention several on Pleistocene features by F. Carney. His inaugural thesis for his doctor's degree at Denison University (Bull. Den. Univ., vol. xiv., p. 335) treats of the glacial phenomena and resulting topography of a part of New York State. The destructive effect of continental ice upon well-bedded and jointed strata beneath is illustrated in Figs. 25 and 26. The same author (*ibid.*, p. 262) has studied the "Raised Beaches" of parts of Ohio, which seem to be glacial lake-terraces rather than raised beaches in the customary sense. They were formed in bodies of water along the frontal margin of the Wisconsin ice-sheet, when it had retreated to the basins of Lake Erie and the other great existing lakes. In accordance with the author's geographic outlook, the terraces are connected by him with the agricultural economics of Ohio. He has also described "Geographic influence in the development of Ohio" in a paper in the *Popular Science Monthly* for November, 1909.

The Grand Cañon of Arizona has attracted D. W. Johnson (Proc. Boston Soc. of Nat. Hist., vol. xxxiv., p. 135) and L. F. Noble (Am. Journ. Sci., vol. xxix., p. 369). The former believes, with W. M. Davis, that the faulting of the district is in the main of ancient date, that is, older than the course of the river. His expedition was chiefly concerned with the examination of this important question. Some modification of Huntington and Goldthwait's report is suggested (p. 157). L. F. Noble's contribution deals with new points in the pre-Cambrian and Palæozoic stratigraphy of the cañon.

C. D. Walcott's progressive Cambrian studies have been referred to more than once in NATURE (see vol. lxxxvii., p. 423). The Smithsonian Miscellaneous Collections have been enriched by them for some years past, and now include (vol. lvii., No. 1) a contribution on the "Abrupt Appearance of the Cambrian Fauna on the North American Continent," presented before the International Geological Congress of 1910. Walcott's view is that life-forms, primarily pelagic, adapted themselves to littoral conditions in Algonkian times, and were first brought over on to the

continental area by the Cambrian marine transgression. Their ancestors are thus to be looked for beneath the existing oceans. The fossils now known from the American Algonkian may have been of fresh or brackish water types; littoral forms were occasionally imported among them from the series continuously developing in the seas. Walcott's studies of the Cambrian faunas of China are continued, with illustrations of new species of trilobites (vol. lvii., No. 4). Evidence is given (*ibid.*, No. 3) that certain medusiform fossils from the Middle Cambrian of British Columbia are in reality holothurians, being characterised by a large spiral alimentary canal. The descriptions and illustrations of these forms possess great interest for all workers among Older Palæozoic strata.

G. A. J. C.

STEREOSCOPIC VISION AND INSTRUMENTS.

WE have received a copy of a brochure entitled "Stereoskopisches Sehen und Messen" (pp. 40, price 1 mark), by Carl Pulfrich. This is the German version, or rather original, of the article "Stereoscope" in the recent new edition of the "Encyclopædia Britannica." A little more detail is given here and there in the German pamphlet than in the "Encyclopædia" article, and the former concludes with a very useful bibliography of papers published in the present century relating to binocular vision, which is not given in the "Encyclopædia." This is to be taken as supplementary to the bibliography in von Rohr's well-known work "Die binokularen Instrumente" (see Supplement to NATURE, March 5, 1908) of memoirs published up to 1900.

The pamphlet gives a concise, but clear and interesting, account of the more important points in the theory of stereoscopic vision; but its main value lies in the brief description which follows of the important modern developments and applications of stereoscopic methods, to which the author has himself so largely contributed. Not the least interesting among these are the well-known stereo-comparator and the so-called "blink" microscope, the latter of which has proved so valuable in the detection of new planets and variable stars. We think it is desirable that attention should be drawn to the very imperfect, not to say unintelligible, translation of Pulfrich's text which constitutes the article in the "Encyclopædia Britannica" above referred to. It is surprising that both translator and editor should have allowed passages to pass which are so far astray from the original. Thus we read: "The reason for this [double images] is that when P (or H′) is *fixed*, the images of H′ (or P) are always separated from one another by the centre of the yellow spot." *Fixed* should be "focussed" (no doubt "fixiert," but the original is here paraphrased). Again: "The power of perception of depth in man is most accurate. *This has been ascertained* by the approximately equal keenness of vision of all normal-sighted people and by the interpupillary distance." This is quite incomprehensible until one learns that the words in italics (ours) are a perversion of "Es wird bestimmt." "Parallax" (Parallaxe) appears as "parallel axis."

It is impossible briefly to convey an idea of the confusion in the mind of the reader caused by numerous errors of this description; but we would strongly recommend all those interested in the subject-matter of the article to refer to Pulfrich's German memoir.

THE TECHNICAL COLLEGE, BRADFORD.

AN important extension of the buildings of the Bradford Technical College was opened by Lord Rotherham on October 25. The extension takes the form of a model experimental mill, in which all processes involved in the production of woollen and worsted cloth, from the raw material to the finished article, can be carried out on a practical scale. The building comprises a three-storey front block 175 feet long, devoted to lecture-rooms, textile testing-room, museum, experimental rooms, &c. Behind this are two large sheds, each 90 feet by 70 feet, one containing the combing, carding, and spinning machinery, and the other the looms. The equipment for the production of yarns of various types is very complete, consisting of Preparing Box, Worsted Carding Engine, Noble Comb, French Comb, French, Cone, and Open Drawing Sets, Flyer, Cap and Ring Spinning Frames. In a separate shed are warping mills and dressing frames, while the power looms include examples of all types. The wool-washing room contains three bowls of a total length of about 80 feet. The practical dyehouse and finishing rooms each have an area of about 300 square yards, and are equipped with full-size machines for the treatment of loose wool, slubbing, yarns, and piece goods.

A detached building houses the power plant, which includes a 30 foot by 8 foot boiler, with superheater, economiser, &c. The engine-house contains four prime movers, a suction gas engine of 125 horse-power, a slow-speed cross-compound engine of 200 horse-power, a high-speed inverted vertical engine of 75 horse-power, and a steam turbine of about the same power. Each of the three engines drives a direct-current generator, while the turbine is coupled to a three-phase alternator. Both engine- and boiler-houses are fitted with a complete set of testing apparatus; but while primarily intended for educational work, the power plant will provide light and electrically transmitted power for three large buildings—the main college block, the extension, and the school of art.

The new buildings have been erected at the cost of about 20,000*l.*, and for the equipment an additional sum of about 14,000*l.* has been provided, which sum would have been much increased but for the generosity of most of the machine makers, who have supplied the equipment on very favourable terms. Much of the machinery throughout the building has been specially designed, so that while of a thoroughly practical character, experimental work not possible in a mill can be carried out.

ZOOLOGY AT THE BRITISH ASSOCIATION.[1]

SECTION D presented a full and varied programme, and the attendance at the several sessions was above the average of recent meetings. This meeting was undoubtedly one of the best of recent years.

As in previous years, there were two lectures of a semi-popular character, which were highly appreciated. Mr. Fred Enock lectured on the "fairy flies" (Mymaridæ), hymenopterous insects of small size and with peculiar delicate wings, without veins, but fringed with long hairs. Mr. Enock, who has devoted many years to the study of this family, illustrated his account by means of a beautiful series of original drawings, shown by the lantern. He described the principal characters of the male and female, and traced the life-history of *Anagrus incarnatus*, the eggs of which are laid in the egg of the frog-hopper.

In his lecture on the fossil reptiles of the Oxford Clay of Peterborough, Dr. C. W. Andrews gave an account of the remarkable assemblage of reptiles occurring in that deposit. The beds in which the remains were found are of Middle Jurassic age, and were probably laid down not far from land and near the mouth of a large river. The horizon at which the remains occur is that characterised by ammonites of the "ornate" group, *Cosmoceras gulielmi* being a common species. Among the remains are those of land reptiles carried down by the river and of many marine forms of several distinct orders. Cetiosaurus, a terrestrial dinosaur allied to Diplodocus, attained a length of 60 feet, the greater part being made up of the greatly elongated neck and tail. Another, but smaller, dinosaur, Stegosaurus, and a pterodactyl, Rhamphorhynchus, were also found. The marine reptiles were more numerous, and of astonishing variety of form; for instance, ichthyosaurs, plesiosaurs of many types, and numerous marine crocodiles of the genera Metriorhynchus and Stenosaurus. The ichthyosaur Ophthalmosaurus was remarkable for the fact that in the adult the teeth were extremely small, and in some cases perhaps absent, so that the food of this animal must have been very different from that of its relatives. In many cases the skeletons were found in a nearly complete condition; in others the carcases seem to have been torn to pieces by predaceous reptiles, the bones being deeply scored by their teeth. Dr. Andrews exhibited a series of lantern-slides showing the actual remains and reconstructions based upon these. He stated that the

[1] "Some Recent Work on Sex" and an account of the discussion on the origin of mammals will form the subject of separate notices.

collection is almost entirely due to Mr. A. N. Leeds, who for the last forty years has closely watched the clay-pits, and has collected most of the specimens, a large series of which is exhibited in the gallery of fossil reptiles in the Natural History Museum at South Kensington.

Momentum in Evolution.

In his opening remarks on this subject Prof. Dendy mentioned that Dr. Smith Woodward, in 1909, had directed attention to the fact that many groups of the animal kingdom, in the course of their evolution, have shown a strongly marked tendency to enormous increase in size, often accompanied by the development of grotesque and apparently useless excrescences. Prof. Dendy instanced as analogous phenomena the extraordinary development of the beak and helmet in the hornbills and of the tusks in the babirusa. In these, and in many other cases which could be adduced, either the entire body or some particular organ appears to have acquired some sort of momentum, by virtue of which it has continued to grow far beyond the limits of utility, although perhaps in some cases a new use may have been found which has assisted the species in maintaining itself in the struggle for existence. An enormous increase in mere bodily size, however, seems in the long run to be always fatal to the race, the place of which will be taken by smaller and more active forms. Prof. Dendy thought there was some ground for believing that a race of animals may acquire a momentum of the kind referred to which may lead ultimately to its destruction, that there is some brake applied to the growth of organs and organisms, but that there are occasions on which the brake may be removed, with results which ultimately prove fatal. He pointed out that the growth of different parts of the animal body is controlled by internal secretions, or hormones, the products of various glands. Disease of the pituitary body leads to acromegaly, one of the symptoms of which is great enlargement of certain parts. Prof. Dendy held that there is good reason for believing that, in the absence of certain specific secretions, the growth of the various organs will continue far beyond the normal limits. He saw no reason why this principle should not be extended to the race, and, paradoxical as it might seem, he thought it possible to explain the growth of the organism as a whole and of its various organs beyond the limits of utility as an indirect result of natural selection.

When a useful organ is first beginning to develop or to take on some new function for which an increase in size will be advantageous, natural selection will favour those individuals in which it grows most rapidly and attains the largest size in the individual lifetime. If growth is normally inhibited by some specific secretion, natural selection will favour those individuals in which the glands which produce this secretion are least developed or least efficient, and, this process being repeated from generation to generation, these glands may ultimately be eliminated, or at any rate cease to produce the particular hormone in question. Moreover, this elimination may take place long before the organ the growth of which is being favoured by natural selection has reached the optimum size. When it has reached this optimum it is certainly desirable that it should grow no larger; but there is no longer any means by which growth can be checked. The inhibiting hormone can no longer be produced; the brake has been taken off, and further growth takes place irrespective of utility, until, when the size of the organ, or it may be of the entire organism, becomes incompatible with the well-being of the individual, natural selection again steps in and eliminates the race. Is it not possible that, the normal checks to growth being thus removed along certain lines by the action of natural selection, a definite direction may be given to the course of evolution which the organism will continue to follow to the bitter end, irrespective of natural selection?

The Food Supply of Aquatic Animals.

Dr. W. J. Dakin directed attention to some of the recent work on the nutrition of marine organisms, first citing the work of Pütter, who showed that there is more organic carbon present in solution in sea water than in the plankton contained in that water. With the view of showing that aquatic animals do use the food in solution, Dr. Dakin adduced the following observations. A specimen of the sponge Suberites, of 60 grams weight, requires as food 22 milligrams of carbon per day, to obtain which the sponge would need to capture 7,400,000,000 *Thalassiosira nana* (or an equivalent of other organisms), and would therefore need to filter several thousand times its own volume of water per hour; but if the food in solution in the sea water be also used, a much more rational quantity of water would suffice to supply the animal's needs. Extraordinarily large numbers of copepods would be required to provide the food of the larger Rhizostomes; but it seems impossible that copepods are captured in such large numbers, for copepod remains are so seldom found in the medusæ. Goldfish living in tap water, without solid food, were able to exist forty-one days; but with soluble organic bodies added to the water the fishes lived seventy-eight days, and the amount of oxygen consumed was found to be in excess of that calculated from the loss in weight of the fish, that is, some oxygen must have been used for the oxidation of substances in addition to those stored in the tissues. Many other facts, *e.g.* that crabs, living in sponges, with only filtered water at their disposal, and that Daphnia can be kept living and growing in solutions containing only dissolved food matter, seem to be in favour of Pütter's theory. Dr. Dakin believed that, though solid food is necessary, food in solution forms part of the normal food supply of aquatic organisms.

Prof. Hartog remarked that there was still much to discover regarding the nutritive apparatus of the lower invertebrates, and that, if Pütter's theory be true, the accessory intestine of some worms and echinoderms, and the rectal pumping apparatus of worms and Crustacea, may serve not only a respiratory, but a nutritive, function. Prof. Herdman suggested that the figures advanced by Pütter were not sufficient either to prove or disprove his contentions, and that renewed investigations are necessary. He also pointed out that copepods, which for a long time were believed not to take solid food, feed on minute diatoms, which, owing to their very small size, had until recently not been observed in the gut of these Crustacea. Prof. Dendy referred to the crabs which live in cavities of sponges, and stated that in most of these cases the crab probably feeds on the sponge, and the latter regenerates as quickly as it is eaten away. Dr. Gemmill stated that one of the difficulties in the way of his accepting Pütter's theory arose from the fact that he was not aware of any soluble organic food material likely to be present in sea water which would not be immediately attacked and broken down by bacteria. Mr. D. J. Scourfield pointed out the great difficulty of estimating the numbers of organisms, and therefore of solid food, present in water, remarking that the rate of increase of smaller organisms, *e.g.* algæ, bacteria, is so enormous that their presence in sufficient numbers in any one catch is not necessary for the explanation of the feeding of the larger organisms, for the small organisms may very soon become so abundant as to provide the necessary amount of food for the larger ones.

The Systematic Position of the Cyclostomes.

Dr. W. W. F. Woodland introduced a discussion on this subject. He described in considerable detail the innervation, musculature, and cartilages (especially the lingual) of the head of cyclostomes, and held that recent work showed that the sub-ocular arch and lingual cartilages could not be regarded as homologous with the palato-pterygo-quadrate bar and glosso-hyal element of gnathostomes. As the musculature of the piston cartilage is innervated by the mandibular nerve, and not by the hypoglossal, modern upholders of the gnathostome ancestry have revived the opinion that the piston cartilage represents the much modified and displaced mandible of gnathostomes, the so-called hyoid representing a quadrate element. Dr. Woodland pointed out that the piston cartilage is not paired, that it does not surround the mouth as mandibular elements should, and held it difficult to believe that it could be a reduced jaw apparatus. The development of the piston musculature and cartilage in the mid-ventral line is inconsistent with the view that they were formerly paired laterally placed mandibular muscles and rami, and the extension of the myotomes laterally in an unbroken series to the extreme end of the head proves that a jaw

apparatus could never have been developed. Dr. Woodland believes, with Balfour, that the branchial skeleton of cyclostomes is not homologous with that of gnathostomes, since, for one reason, in the former the skeleton is developed external to the ventral aorta and the gill vessels, while in the latter it is internal. He concluded that, considering the visceral arches as a whole, it is incredible, if the cyclostomes have originated from a gnathostome stock, that the first two visceral arches should exhibit the differences in development (in time and form) and relationships to nerves and muscles shown by the sub-ocular arch, piston, and styloid cartilages, &c., when compared with the jaw and hyoid arches of gnathostomes.

Prof. Dendy, while agreeing generally with Dr. Woodland's position, pointed out that the lampreys and hags differ markedly from each other. The brain of Petromyzon is primitive, and in Geotria there are two pineal eyes—a very primitive character; the brain of Myxine is highly modified, and pineal organs are wanting. These and other facts suggest that the two subdivisions of the cyclostomes have either had a separate origin or have diverged early from one another.

Mr. E. S. Goodrich held that the absence of jaws in cyclostomes was not proved; the piston apparatus is supplied by the fifth nerve, and this region would therefore seem to be homologous with the mandibular region of the gnathostomes. The gill arches of larval lampreys resemble those of gnathostomes, and though the relations of the branchial basket of lampreys and the gill arches of gnathostomes are not identical ventrally, their relations dorsally are very similar, and therefore the homology of these structures is not disproved. Mr. Goodrich suggested that the piston cartilage of Petromyzon might be homologous with the median cartilages of the branchial apparatus of gnathostomes. He demurred to the suggestion that lampreys and hags have been independently derived from the primitive vertebrate stem, for the two series present certain common characters, *e.g.* the structure of the gills and heart, asymmetry of the vascular system, horny teeth and piston apparatus, hypophysial sac in relation to the nasal organ, which it is unlikely can have been developed independently. He regarded the cyclostomes as monophyletic, and as having diverged very early into two branches, the lampreys and the hags.

Communications on Protozoa.

Prof. Herdman contributed a note on the occurrence of the peridinian *Amphidinium operculatum* at Port Erin. This flagellate organism had not been previously recognised in British waters, and was known only from the coasts of Norway and Belgium. It was first observed at Port Erin early last year, forming brown patches in the troughs of the ripple marks on the beach about half-tide level. The patches varied in size, but were observed for about three weeks. Examination of the sea water in the neighbourhood of the patches showed that the organism was not living in the water; it lived only in the wet sand. The brown patches consisted of an almost pure culture of Amphidinium, the only admixture being a very few examples of a diatom (Navicula). Later in the year brown patches of similar appearance were again observed on the sand, but on examination they were found to consist entirely of Navicula. The Amphidinium had disappeared, but the Navicula had multiplied abundantly. Prof. Herdman cited this as a striking instance of the change in the organisms inhabiting the beach, a change which might readily be, and no doubt had long been, overlooked.

Major C. F. Bishop described his recent examinations of sheep suffering from louping ill, and of ticks which had fed on the sheep. On a film made of blood squeezed from a tick, taken from a sheep which was said to be a typical case of louping ill, he found a single "trypanosome," about 22 μ long, in which the trophonucleus was nearly central and anterior to it the large kinetonucleus. Trypanosomes have not yet been found in any of the sheep examined, but Major Bishop considered it probable that the organism described was connected with the disease in the sheep. He also described other forms which he considered to be blood parasites, and regarded as flagellates, in films of blood from sheep.

A New Hydroid, Epizoic on a New Parasitic Copepod.

Prof. H. F. Jungersen (Copenhagen) described a new hydroid, *Ichthyocodium sarcotretis*, which covers more or less of the exterior of the parasitic copepod *Sarcotretes scopeli*, n.sp., which is deeply sunk into the body of the fish *Scopelus glacialis*. The hydroid consists of polyps, without tentacles, arising from a network of delicate tubes. From the base of the polyps arise medusa-buds which develop into free medusæ (Anthomedusæ). This new hydroid is a corynid, related to *Hydrichthys mirus*, Fewkes, epizoic on the fish *Seriola zonata*. Prof. Jungersen gave a full description of the characters and life-history of the copepod, which belongs to the family Lernæidæ. There is first a "cyclops stage," capable of moving about on the host and attaching itself by means of its strong cheliform antennæ; the pupa stage is passively fixed to the host by means of a hardened secretion from the rostrum. Within the last pupal phase the copulatory form was observed. The latter probably is for a time free-living; after impregnation the female assumes parasitic life anew, but in a more intense form; it pierces the skin of a Scopelus, and, gradually growing, it penetrates the muscles, and finally reaches the intestine. This copepod is found on examples of Scopelus from the eastern part of the Atlantic, and the triple association—hydroid, copepod, fish—seems to be a regular one. The loss of tentacles of the hydroid polyps seems to indicate that the hydroid in some way or other depends on the fish for obtaining its food.

Variation in the Medusa Mœrisia lyonsi.

Mr. C. L. Boulenger gave an account of variations in this Egyptian lacustrine medusa. About 15 per cent. of the individuals examined were abnormal. The abnormal examples fall into two groups: (1) those which deviate from the normal four-rayed symmetry, and (2) those with the normal number of radial canals and primary tentacles, but possessing, in addition, secondary tentacles which are not connected with the stomach by means of radial canals. Some of these multitentacular forms are asymmetrical, and it seems that each quadrant is capable of forming secondary tentacles quite independently of the other quadrants.

The Crop of the Leech.

Prof. Marcus Hartog directed attention to the structure of the septa in the crop of the leech. The crop is divided into chambers separated by distinct simple septa passing inwards from the obvious external constrictions and perforated by a central aperture, circular under ordinary conditions, but vertically elongated in distension. The septum is puckered at the free edge, and contains a circular sphincter, but no divaricator fibres. This structure has probably been so long overlooked because it is inconspicuous in ordinary dissections, and is not easily recognisable in the usual thin transverse sections; it is well seen on examining successive thick slices of a hardened, distended leech.

The Lantern of Aristotle as an Organ of Locomotion.

Dr. J. F. Gemmill gave an account of his observations on the locomotor function of the lantern of Aristotle in the sea-urchins *Echinus esculentus* and *E. miliaris*. The animal progresses, when out of the water, by a series of steps or lurches, more or less well defined, in each of which the urchin is raised on the tips of the teeth as on a powerful central stilt. The steps have a length varying from half an inch downwards, and are repeated at intervals of fifty seconds or less, according to the size of the urchin. There is a rhythmic backward and forward swing of the lantern in the direction of progression. The backward swing is accompanied by powerful protrusion of the tightly closed teeth against the supporting surface, which causes pushing or poling forward of the urchin. The movement is aided by pushing on the part of the spines, and, after a certain stage, by the action of gravity. The forward swing of the lantern is marked by retraction, with opening of the teeth, and serves to bring the latter into position for initiating a new lurch. Experiments on loading, recording surfaces, inversion, equatorial section, rotation, removal of spines, &c., were also briefly noted, and examples of tracks

left by the spines and teeth on a smooth plasticine surface were exhibited with the help of the lantern.

Healthy urchins, moving under water over approximately horizontal surfaces, do not, as a rule, use the lantern for movement, the greater part of their weight being neutralised by the water. There are, however, certain conditions, both normal and experimental, in which the lantern plays an important part in locomotion. Dr. Gemmill brought forward evidence in favour of the view that the locomotor action of the lantern is a particular manifestation of a fundamental rhythmic activity, which can also subserve feeding, boring, respiration, and circulation, and possibly, in addition, the maintenance of turgescence within the ampullæ of the water-vascular system.

Dr. Gemmill also gave a lantern demonstration on the development of the star-fish, *Solaster endeca*.

Echinoderm Hybrids.

Mr. H. M. Fuchs presented observations on the experimental control of dominance in echinoderm hybrids, using *Echinus miliaris* and *E. acutus*. Dr. Shearer and Mr. de Morgan had found that when these two species are crossed the characters of the hybrid larvæ are always the same as those of the maternal parent, and this was found by Mr. Fuchs to hold good also when the eggs were kept, during the cleavage period, in sea water with increased and decreased OH ions.[1]

The Gonads of the Urchin Echinocardium cordatum.

Prof. Caullery (Paris) traced the annual cycle of changes in the gonads of this urchin. From July to the end of the year the gonads are almost entirely composed of large cells, each of which contains a vacuole and numerous spherules of reserve substance. In males these cells exhibit, among the reserve material, numerous spermatozoa, agglutinated into pockets, which have been ingested by the cells; in females, fragments of degenerating ova are seen between the cells. At the periphery of the gonad there are either small masses of spermatogonia or oocytes. Growth of the genital products takes place, in part owing to the presence of the reserve-laden cells, at the end of winter, and the period of maturity, at Wimereux, extends from April to the end of May. The reserve-containing cells are gradually pushed towards the centre of the acini, and in some localities, *e.g.* Naples, disappear, but at Wimereux they do not fully disappear. Up to the end of May there have been formed, in the testes, for example, only the sexual cells, but henceforward there are produced numerous cells, each of which elaborates groups of granules and contains a large vacuole. This is the new reserve tissue, which soon forms a continuous peripheral layer. By the end of June the sexual elements in course of formation exhibit signs of degeneration, *e.g.* fragmentation of the oocytes and pycnosis of the spermatogonia, but ripe sexual products are for some time longer emitted. After July the emission ceases, and the sperms remaining in the testis become agglutinated and are ingested by the reserve cells, which gradually occupy the whole gonad. In star-fishes there is no reserve tissue, and the gonads, after having almost filled the arms, become so much reduced as to be almost imperceptible.

Observations on Boring Molluscs.

Mr. W. T. Elliott and Miss B. Lindsay described observations on *Zirphaea* (*Pholas*) *crispata* and *Saxicava rugosa*, made on the shore at St. Andrews, which confirm the statement of Prof. McIntosh that the method of boring of these molluscs is mechanical, and not chemical. Both molluscs work by means of a partial vacuum produced by cooperation between the mantle and foot, supplemented by scraping movements of the shell, which in Zirphæa are continuous and progressive during the time of boring. Reference was made to the importance of boring organisms in connection with coast erosion.

[1] These experiments were prompted by recent work of H. D. Tennent (1909, 1910) who crossed Hipponoe ♂ × Toxopneustes, ♀ and T. ♂ × H. ♀, obtaining in both cases larvæ with a preponderance of Hipponoe characters. By keeping the eggs, during the cleavage period, in sea water with increased and decreased concentration of OH ions he claims to have altered this dominance and states that a decrease of OH ions gave Toxopneustes characters.

The Species of Balanus Collected by the "Siboga."

Dr. P. P. C. Hoek (Haarlem) gave an account of some of the species of Balanus collected in the Malay Archipelago during the cruise of the *Siboga*. Of the twenty-seven species collected, nineteen are new. Few species were brought up from great depths; most of them were taken at a not greater depth than 90 metres. Some were brought up from 564, 289, 216, 275, 304, and 390 metres respectively, but the species represented in the first three cases were collected also at a depth of less than 100 metres. Dr. Hoek described some of the features, especially the labrum, which he had used in classification.

The Renal Organs of Squilla.

Dr. W. N. F. Woodland described the renal organs—maxillary glands—of Squilla. In an Erichthus larva 2 mm. long the gland consists of a short narrow tube, opening externally on the maxilla and ending internally in a slightly dilated end sac. In an older larva, 12 mm. long, the gland has become divided into two thin-walled compartments—the kidney proper and the end sac—lying side by side and communicating by a small aperture at their posterior ends. A little later the walls of the gland become invaginated, forming internal lamellar folds containing extensions of the hæmocœle, a process which continues so extensively that, in the adult, the cavity of the gland is almost entirely broken up into a network of spaces. Other features of the internal anatomy were also referred to, namely, the presence of a well-developed nauplius eye, rectal glands, and a very short proctodæum, which forms a wide cloaca-like cavity.

A Reconstructed Trilobite.

Dr. Malcolm Laurie gave an account of the anterior end of a trilobite (Calymene), which he has studied by means of grinding away definite and very thin layers of the fossil, photographing each exposed surface and reconstructing the specimen in wax on an enlarged scale. He exhibited the reconstruction, and pointed out that, although the mouth has been considered as opening behind the hypostome, the size and form of the latter render it improbable that the mouth opened behind it. Apparently the anterior margin of the hypostome projected ventrally, while the inturned margin of the neighbouring carapace also projected ventrally, the two forming lower and upper lips respectively to the mouth. In a line between the lateral margin of the glabella and the eyes there is a long conical structure, more than two-thirds the length of the carapace, divided into joints by annular thickenings. It is impossible to state certainly whether this is *in situ*, but its structure resembles that of an antenna. If it be such it must have been attached to the body behind the hypostome, as otherwise it could not have been withdrawn when the animal rolled itself up. This appears to be another instance of a post-oral appendage assuming an antennary function, as in Phrynus and Thelyphonus.

British Symphyla and Diplopoda.

Mr. R. S. Bagnall gave a rapid survey of the British Symphyla, pointing out the characters of the genera Scutigerella and Scolopendrella and of some of their species. A year ago only one species of the former was known from Britain; in 1904, when Hansen's monograph of the order appeared, eight European forms were recognised; of these, six have now been found in the north of England, and there have also been discovered four other well defined and apparently new forms. Mr. Bagnall recognises four species of Scutigerella and seven of Scolopendrella. He also recorded four diplopods from the north of England, each of which represents a genus previously unknown to the British fauna, and, from the same locality, a new pauropod, the first British example of the Eurypauropodidæ.

Mimicry in African Butterflies and Moths.

Prof. E. B. Poulton exhibited three groups of mimetic butterflies collected at Entebbe, Uganda. These groups were centred round species of the distasteful family Acræinæ. Among the mimics were species of Acræinæ, showing that members of this family acted as mimics and models, a fact supporting the theory of Fritz Müller as

against that of Bates. There were also acræine mimics which mimicked other species of the same family, themselves mimics of the primary acræine models. The rest of the exhibit was concerned with examples from Lagos, among which was a caterpillar of a well-known moth (Nyctemera), which before becoming a chrysalis secreted and covered itself with a mass of bubbly froth, which on hardening resembled the cocoons of a braconid parasite, and probably acted as a protection against insectivorous birds or lizards.

The Scent Patches of Lepidoptera.

Dr. F. A. Dixey described the scent patches of certain butterflies and their associated tracheæ. The males of many butterflies possess the power of emitting a scent, which is apparently attractive to the female. The scent patches are best distributed in Pierinæ (*e.g.* the orange tip). The apparatus consists of specialised scales scattered over the upper surface of the wing of the male. The scent is elaborated by cells in the wing membrane; the oil enters the specialised scale at its basal foot-stalk, and escapes by fimbriæ at the distal end of the scale. In other cases (*e.g.* the clouded yellow) the scent scales are aggregated into patches, so arranged that, in the ordinary position of rest, the patches of the fore- and hind-wings are coincident. The scales of these patches have neither foot-stalk nor fimbriæ. In some species of Catopsilia there are two specialised scale patches, which Dr. Dixey found to be provided with a special tracheal supply derived from the larger tubes in the wing veins. On reaching the scent patch the main tracheal trunks were found to break up into branches, the ultimate distribution of which was not ascertained, but appeared to bear a definite relation to the scent scales. Dr. Dixey suggested that the tracheæ were concerned in the dispersion of the perfume through the scales, acting in the manner of a *vis a tergo*.

The Biology of Eels.

Dr. Johs. Schmidt (Copenhagen) gave an account of five years' Danish investigations on the biology of eels. These have shown that the biology and reproduction of the conger and eel are more complicated matters than they seemed after the publication of Grassi's work. In the case of the eel, the youngest stages found are 4 cm. in length, and it is therefore not yet possible to state exactly where in the Atlantic the eel spawns, except that it must be outside the continental slope. All the larval stages, even the youngest (but not the eggs), of the conger are known, and it can now be stated that the conger spawns everywhere in the Mediterranean and in the Atlantic west of Gibraltar; how far west is not yet ascertained, but the half-grown larvæ of *Conger vulgaris* have been taken near the Azores. These investigations have not confirmed the earlier suppositions (of Grassi) that the larval development of eels takes place at the bottom of the sea or in great depths. All the murænoid eggs (several thousands) were taken near the surface of the sea, as were also the youngest pre-leptocephalic stages, *e.g.* of *Conger vulgaris* and *C. mystax*. The full-grown larvæ of the eel and conger also occurred in the upper layers. Murænoid eggs were found not only in the Mediterranean, but also right across the Atlantic between 20° and 40° N. lat. Evidently, therefore, some eels spawn there, but how far from the surface has not yet been ascertained. Dr. Schmidt illustrated his remarks by charts and a beautiful series of larval and metamorphosing examples of several species.

The Dorsal Vibratile Organ of the Rockling (Motella).

The dorsal vibratile fin of the rockling, which has been believed to be a lure, is regarded by Dr. J. Stuart Thomson as an organ for producing a current of water over numerous terminal or taste buds situated in the skin of that region of the body, which thus functions as a gustatory organ. These taste organs are distinguished from the lateral line organs by certain structural differences and by the fact that they are innervated by the recurrent facial nerve, the root of which is in the facial lobe of the medulla, which lobe has been described by Herrick as part of the gustatory tract. Dr. Thomson's experiments indicate the existence of a gustatory reaction in the rockling, some of the most successful responses being obtained on placing Arenicola in proximity to, but not in contact with, the taste buds of the region under consideration.

A Remarkable Egg of the Kestrel.

Prof. Patten commented on an egg laid by a tame kestrel, which has been in his possession eight years. The egg is normal in size, but milky-white in colour and almost unspotted except at its larger end; there are spots and blotches of rich purple-brown intermixed with greyish-purple, the whole pigmentation forming a broken zonular band. Dr. Patten suggested that a highly nutritious hearty meal, coming after a fast, and in a warm change of weather, may have toned the bird to such a physiological state that the ovaries became sufficiently active to induce ovulation.

Prof. R. J. Anderson brought forward a number of details regarding the constitution of, and variation in, the manus and pes of Primates, and contributed a note on the manus of a young Indian elephant.

J. H. ASHWORTH.

OLD AND NEW VIEWS ON THE TREATMENT OF CONSUMPTION.[1]

DR. THEODORE WILLIAMS stated that 255 years had elapsed since William Harvey instituted this festival, and that orations had been delivered in Latin or English ever since in commemoration of benefactors, and with Harvey's exhortation to the fellows and members to study out the secrets of nature by way of experiment, and to continue in mutual love and affection among themselves. He then proceeded to review the various steps of Harvey's great discovery of the circulation of the blood, and remarked that its author, in spite of the severest criticism, lived to see it firmly established in the annals of medicine and to witness the conversion of the greater number of his opponents. The seed sown by this discovery, based on observations and experiments, and put forth with convincing logic by this most accurate observer, had revealed to the world further scientific truths, which have been elaborated by Harvey's successors in the arts of medicine and of surgery, and have brought forth a harvest of improvements—physiological, clinical, pathological, and therapeutical—which added immensely to the total sum of human health and happiness. Dr. Williams instanced as examples the administration of anæsthetics, intravenous and hypodermic injections, and treatment by vaccines, while auscultation and the graphic methods of measuring blood pressure and rhythm might also be counted as outcomes of the knowledge initiated by Harvey's discovery.

Harvey's views on tuberculosis are not known, though his lost "medical observation" may have treated of these; but the lecturer sketched the doctrines held by his contemporaries on this subject, and the treatment in vogue, the former being somewhat obscure and the latter mingling with hygienic and dietetic rules, which were to some extent reasonable, prescriptions containing woodlice, crabs' eyes, the simple powder of crabs' claws, red coral and white amber in the form of powders or julep to "temper the sharpness of the blood." The Royal touch for the King's Evil continued to be believed in until a much later date. Most of the theories of that time assigned the cause of consumption to errors of digestion or in the formation of lymph or chyle or blood, or to defective respiration; but they chiefly dwell on the inflammatory origin, and though long suspected, the *vera causa*, viz. the tubercle bacillus, was never definitely proved until Robert Koch appeared on the scene. Laennec and other observers had meantime given scientific accounts of the morbid anatomy of tubercle, and the treatment had changed from an anti-inflammatory *régime* depending largely on blood-letting to a tonic and building-up system,

[1] Abstract of the Harveian Oration delivered at the Royal College of Physicians on October 18 by Dr. C. Theodore Williams.

fortified by a liberal dietary, by the use of cod-liver oil and by climatic treatment.

Dr. Theodore Williams, at the express wish of the president of the college, proceeded to sketch the evolution of the treatment of consumption as it had come under his own cognisance during his nearly fifty years of professional experience. He spoke of the effects of climate, and especially of that of high altitudes; then of the open-air life which had first been advocated in England by Bodington and Henry MacCormac, and was now accepted as essential in cases of tubercular disease. Dr. Williams had personally studied the climates most advantageous for the treatment of consumption in the New and the Old Worlds, and had given a full trial to mountain climates, having recorded their effects on more than 400 of his private patients, and studied the results of the diminished barometric pressure, of the diathermancy of the air, and of the asepticity, or freedom from pathogenic germs, which are characteristic of high-altitude climates.

He found the effects on selected cases of chronic tuberculosis remarkable: many symptoms vanished, and muscular power increased largely, while the local improvement was even more striking, and in many early cases of consolidation the disappearance of physical signs was so complete that the physician had to refer to his notes to discover which lung was originally attacked! In fact, the high-altitude cases yielded the most favourable results of all his statistics, and, what is more important, the fewest relapses.

He then noticed the establishment and spread of sanatoria all over the world, and said that in Germany alone the insurance societies now maintain more than 16,000 beds for the working classes; and he directed attention to the methods pursued, including rest, with or without Liegehalle, good feeding, graduated exercise, and labour supervised to meet individual requirements, which have all been tried at different sanatoria, giving the results achieved thereby. He described the system pursued at some of the best English institutions, where the patients with limited tuberculous pulmonary lesions, when removed to thoroughly hygienic surroundings and compelled to lead a healthy life, their food, exercise, and rests being under minute skilled direction, may slowly and gradually recover, and, losing symptoms, be able to return home to active working life, ready and able to instruct those around them in the gospel of fresh air and wholesome living.

But Dr. Williams emphasised the need for discovering and treating *early* cases of the disease, and though agreeing in the general truth of the curability of consumption, he felt obliged to except the acute cases, which, however, fortunately form a very small percentage of the whole.

He contended that the pressing need is for more hospitals for consumption—England had been a leader in establishing these, and now it is recognised that the consumption hospital is required as a centre from which to draft off cases suitable for sanatoria, as well as for the treatment of more advanced and acute cases, which are thus isolated from the rest of the population and prevented from becoming centres of infection.

Dr. Theodore Williams spoke of the modern treatment of consumption by anti-tuberculous serums and vaccines, and gave the experience of others and of himself, concluding by the remark that everything points to the necessity for further investigation, and that such investigation can be best carried on in hospitals and sanatoria, where trained observers minutely watch the effect of tuberculin on the patient's system and control the inoculations and their results. He summed up with a bird's-eye view of the present state of the crusade against tuberculosis in this country and our means of pursuing the fight.

He reminded his audience of what had already been done by the blessed agencies of prevention, such as improved drainage, more cubic space, and less overcrowding, better food and more of it, more air and sunlight, cleanliness of house and person, and increased opportunities for play and exercise, and how, mainly by these means, the phthisis mortality had been reduced two-thirds in fifty years.

A good town-planning scheme should prove a fine weapon in the hands of the combatants. Education of all classes, including the children, must be promoted, and that with the tuberculosis exhibitions and popular lectures and tracts which now permeate and enlighten the country, will be found to be trusty armour and show the people how they can help themselves.

Prevention is naturally what is to be aimed at; but for the consumptives who are now among us are needed as links in the chain:—

(1) Well-equipped consumption hospitals to receive and isolate acute and advanced cases.

(2) The dispensary system, introduced by Dr. Philip, and now at work in several metropolitan boroughs, which, with the out-patient departments of consumption hospitals, can classify the patients, visiting them and contacts in their own homes, and connecting them with local government and philanthropic agencies.

(3) The sanatorium, and especially those institutions which make a feature of preparing the patient by various grades of labour for return to a workaday world.

(4) Labour colonies and exchanges to assist in the rehabilitation of those who have been smitten with the disease, or may be more liable to reinfection, or may require the safeguard of a changed and more healthy occupation.

The task of further reducing, and finally abolishing, tuberculosis is not a hopeless one, but it does not lie wholly with the doctors. It lies also with those who have it in their power to remove and lessen the principal causes of tuberculosis, viz. the overcrowding of our cities, the want of open spaces and of ventilation, the insanitary houses, the disgusting habit of spitting, and the lack of a good supply of water and of pure milk. Philanthropists, together with local government authorities administering under our Minister of Health, might remedy these defects and ensure that the number of phthisis cases should be in future comparatively small.

The great Harvey would smile with pleasure as he realised our successive advances in knowledge and the attempts to remedy our deficiencies, and he might well receive our laurel crown as the leader who showed the way to those who are now searching out the secrets of nature by way of experiment.

UNIVERSITY EDUCATION IN ENGLAND AND WALES.

ATTENTION has been directed already (NATURE, September 21, vol. lxxxvii., p. 407) to the Blue-book containing the reports for the year 1909–10 from those universities and university colleges in Great Britain which participate in the Parliamentary grant for university colleges. In the notes referred to, information was given as to the amount of the Treasury grant, particulars concerning the incomes of the various colleges, and similar data.

An introductory report by the Board of Education, with which the volume opens, contains much that deserves careful study by all who are interested in the progress of higher education. A number of extracts from this prefatory memorandum are subjoined.

The weakness of the appeal which university education makes in the present day to the imagination of the wealthy finds its counterpart in the apathy of the public at large, and this apathy is only too frequently reflected in the attitude of the local authorities. Some of the most important of these give far less than their proper share of support to the universities, and in one or two instances the maintenance at their present level of the grants made by local education authorities has been endangered. On the other hand, in two instances there has been a notable increase in the amount of the support received from this source. As the result of representations made by the Right Hon. Joseph Chamberlain, M.P., the Chancellor of the University, the City of Birmingham has promised to increase

its grant in aid of the University of Birmingham from ½d. to 1d. rate. The exact amount of increased support thus given to the University is, however, for the moment uncertain, because the University has been required by the municipality to devote an as yet indeterminable portion of the additional grant to the establishment of maintenance allowances and scholarships to poor students. Since the fees paid by students never equal the cost of the education they receive, it follows that the net amount of the increased aid to the University will be something less than the difference between the gross increase and the sum devoted to maintenance allowances and scholarships. If, as there is reason to hope will be the case, the grant is continued at the higher level for future years, the extension of the boundaries of the city will lead to a further increase in the amount received by the University unless this additional income has to be expended on scholarships or bursaries. The Corporation of Newcastle-upon-Tyne has recently made an additional grant of 1500*l.* a year for five years to Armstrong College. This additional grant is the more noteworthy because it has been made for the special purpose of developing the faculty of arts, a faculty which does not, as a rule, appeal so directly to local sympathies as do the faculties of pure and applied science.

The problem of university education in the metropolis does not grow easier as time advances; the need for that help and guidance which only a well-organised university can afford increases yearly. The many independent institutions and authorities working in the field of operations are conscious, each in its own way, of the growing demand for instruction of a high order, and of the urgent necessity for increased means of providing it, and it is not to be wondered at if they attack the problem as best they may, without considering too closely the effects of their action upon their neighbours. Yet no satisfactory issue is possible on these lines. The Board is endeavouring for the moment to avoid encouraging this confusion, but nothing really far-reaching can be attempted until after the Royal Commission appointed in 1909 has completed its labours.

This need for a proper scheme of coordination is perhaps especially urgent in the case of higher technological and professional work; it is not confined to London. Until the problem has been adequately dealt with, it is almost impossible to deal wisely with even the most urgent claims for further development. Yet there is undoubtedly a great need for considerable further provision of the highest type of instruction. The fifth annual report of the British Science Guild contains certain rough comparisons between the number of properly equipped day students attending the *technische Hochschulen* in Germany and the numbers of day students doing work of a kind more or less comparable in this country. The comparison shows that after making full allowance for the larger population of Germany, there are more than twice as many such students in Germany as in Great Britain and Ireland. If the inquiry could be more exact, and if only those students in this country were included who had received the same amount of previous general education, and were giving the whole of their time to higher technical studies, it is certain that the comparison would be even less favourable.

But if the problem in regard to technology is to discover how to make a wise increase in the amount of provision without the incidental waste which comes from unnecessary overlapping between competing institutions, the problem in connection with medical education is quite different. What is needed here is concentration and coordination of effort and the greater efficiency that will then alone be possible. There is probably more than sufficient provision made for medical education in these islands; it is a question whether, even now, after years of shrinkage in the numbers of men entering the medical profession, the output is not still in excess of the national needs. Nowhere is this excess of provision more evident than in the metropolis. The difficulties inherent in the position are obvious, particularly at the present moment, when public opinion has not yet been fully informed as to the true relationship between the hospital and the medical school, or as to the invaluable services which a progressive school renders not only to the treatment of the sick poor, but also to the national medical service. To the closeness of this relationship, on the other hand, is due the facilities for access to clinical study which London offers to a greater degree than any place in the world. Any change which endangered this advantage would be very dearly bought.

Of the twenty-three general medical schools in England, all but five (including Oxford and Cambridge) have now applied to the Board for grants in aid of the instruction they give. It is hoped it may be possible to include in the next volume of these reports returns from the medical schools in receipt of grant from the Board analogous to those now received from universities and university colleges in receipt of aid from the Exchequer. It is not unreasonable to anticipate that these reports will afford a valuable basis for a general consideration of the many problems in regard to medical education existing at the present time.

Reference was made in the introductory report last year to the tutorial classes which have been established on the initiative of the Workers' Educational Association. Although, as explained in that report, the education given in these classes cannot properly be called university education, yet the universities have throughout been so closely connected with their organisation that some further reference to them seems not inappropriate. During the current session there are nearly seventy of these classes at work, or nearly double the number in existence last session. The rapid growth of the classes continues to afford undoubted evidence of the extent to which they are meeting a real need. Further development was made last year, when a summer school was established for the first time. The school was held in Oxford during July and August, and was intended for students who had attended tutorial classes during the previous session. As students could only remain for a week, or at most a fortnight, the lectures and instruction for each week were arranged to deal with a particular subject or group of subjects. An important part of the students' work consisted in writing essays, which were subsequently read and discussed with special tutors. The arrangements were necessarily somewhat experimental, but there seems little doubt that the students greatly appreciated the establishment of the school, and derived much benefit from it. Grants were paid by the Board of Education in aid of the classes held during the session 1909–10, and also in respect of the summer school. During the session the Board arranged for a special inspection of some of the classes, and the report was subsequently made public. The report fully confirmed the high opinion already existing as to the value of the classes.

The accompanying table presents an analysis of the students under instruction in England and Wales during the academical year 1909–10. The revised form in which the returns of students has been compiled by the universities has rendered it possible to make this table more detailed than before. The table also gives more accurate figures than have been hitherto available as to the number of students being prepared by university institutions for matriculation examinations.

The number of part-time students of all kinds in England reaches the large figure of more than 13,700, or more than half again as large as the number of whole-time day students. Only about 1200 of these were reading for degrees or attending post-graduate courses. A considerable proportion of the remainder only attended short courses; but even so it is evident that there is as yet no sign of any relative decrease in the demand being made upon the universities for work which, excellent and useful as it is, cannot be described as university work in the strict sense of the term. It is to be hoped that as time goes on, and as the secondary schools of the country make their influence more clearly felt, the relative growth in the number of full-time students properly equipped for university studies will increase.

The number of day students under seventeen is but 2·5 per cent. of the total, and the number under eighteen is less than 10 per cent. of the whole number of day students. These figures are encouraging, and as compared with the figures for ten years ago, if these could be obtained, would probably show an increase in the age at which the majority of the students are entering upon university courses now. In proportion as the length of school life in the secondary schools increases, the percentage of day students entering the universities under

Analysis of Returns of Students under Instruction, 1909–10.

Name of University or College	Full-time Students: Degrees: Training College Students	Degrees: Other Students	Degrees: Total	Diplomas (Non-graduate): Training College Students	Diplomas: Other Students	Diplomas: Total	Post-graduates	Other Students	Total of Full-time Students	Matriculation Students	Total of Degree Students	Total of Diploma Students	Total of Post-graduate Students
ENGLAND.													
1. Birmingham University	113	414	527	134	81	215	30	50	822	—	527	215	66
2. Bristol University	57	197	254	195	91	286	14	4	558	27	260	322	32
3. Leeds University	141	285	426	6	106	112	20	148	706	—	454	132	37
4. Liverpool University	251	432	683	4	185	189	123	13	1008	—	703	209	153
5. Manchester University	204	736	940	55[1]	110	165	155	154	1414	31	1012	166	198
6. Sheffield University	79	123	202	1	67	68	6	69	345	5	211	244	18
London University :—													
7. University College	90	406	496	—	71	71	152	178	897	17	571	84	423
8. King's College	88	264	352	—	137	137	43	14	546	79	472	198	134
9. Bedford College	45	143	188	—	18	18	29	10	245	16	188	18	38
10. School of Economics	—	70	70	—	1	1	32	80	183	—	181	2	95
11. East London College	46	110	156	—	—	—	2	—	158	63[2]	278	—	21
Durham University :—													
12. Newcastle, Armstrong College	90	161	251	110	48	158	6	102	517	—	251	158	11
13. Nottingham University College	61	65	126	90	24	114	3	—	243	28	134	295	4
14. Reading University College	54	61	115	76	51	127	11	71	324	13	122	127	12
15. Southampton, Hartley University College ...	42	46	88	106	9	115	5	—	208	9	98	157	13
16. Totals—England	1361	3513	4874	777	999	1776	631	893	8174	288	5462	2327	1255
WALES.													
University of Wales :—													
17. Aberystwyth University College	140	297	437	—	8	8	11	15	471	11	437	8	11
18. Bangor University College	113	167	280	—	11	11	15	10	316	—	280	11	15
19. Cardiff University College	186	288	474	—	68	68	5	29	576	1	474	68	11
20. Totals—Wales	439	752	1191	—	87	87	31	54	1363	12	1191	87	37

[1] Eight of these were students in training who were reading for the Teachers' Diploma (post-graduate).
[2] Twenty-five of these were following degree courses though they had not matriculated.

eighteen will probably fall. In Wales secondary education has been organised for a greater length of time than in England, and this is probably one of the causes for the smaller percentage of day students under eighteen in the Welsh colleges.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At the annual general meeting of the Philosophical Society, held on Monday, October 30, the following were elected officers:—*President*, Prof. Sir George Darwin; *vice-presidents*, Prof. Newall, Prof. Hopkinson, Prof. Wood; *treasurer, Prof. Hobson*; *secretaries*, Dr. Barnes, Mr. A. Wood, Mr. F. A. Potts; *members of council*, Prof. Sir J. Larmor, Prof. Biffen, Prof. Pope, Mr. R. H. Rastall, Mr. K. Lucas, Mr. E. A. Newell Arber, Prof. Sir J. J. Thomson, Mr. J. E. Purvis, *The Master of Christ's*, *Mr. R. P. Gregory*, *Dr. Cobbett*, and *Mr. J. W. Mercer*. The names of the new members of the council are in italics.

At Christ's College, Dr. H. J. H. Fenton, F.R.S., and Prof. E. W. Brown, F.R.S., of the Yale University, have been elected honorary fellows. The same honour has been conferred at Emmanuel College on Mr. R. H. Biffen, prælector in agriculture, and on Mr. F. G. Hopkins, F.R.S., prælector in biochemistry at Trinity College, formerly fellow and tutor of Emmanuel.

T. G. Bedford has been appointed demonstrator of experimental physics, and J. A. Crowther and H. Thirkill assistant demonstrators.

The electors to the Allen scholarship give notice that they are prepared to receive applications from candidates. Any graduate of the University is eligible for the scholarship provided that his age on the first day of the Lent term 1912 does not exceed twenty-eight years. This year the scholarship is open to candidates who propose to undertake research in any branch of study which comes within the department of any of the following special boards:—medicine, mathematics, physics and chemistry, biology and geology. The emolument of the student is 250*l*., or such smaller sum as the fund, after payment of all expenses, shall be capable of providing. Candidates must send their names to the Vice-Chancellor on or before February 1, 1912.

The electors to the Isaac Newton studentships give notice that an election to a studentship will be held in the Lent term, 1912. These studentships are for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics. The persons eligible are members of the University who have been admitted to the degree of Bachelor of Arts, and are under the age of twenty-five years on the first day of January, 1912. The studentship will be tenable for the term of three years from April 15, 1912. Candidates for the studentship are invited to send in their applications to the Vice-Chancellor between January 16 and 26, 1912.

The special board for biology and geology gives notice that the Gedge prize will be offered for competition in the Michaelmas term, 1912. The prize will be awarded for the best original observations in physiology. The essays are to be sent to the professor of physiology not later than October 1, 1912. The examiners may require every candidate to deliver his essay in the form of a lecture.

OXFORD.—The statute exempting candidates for honours in mathematics and natural science from compulsory Greek is approaching its final stages. On Tuesday, November 7,

it will come before Congregation, as amended in the course of last term. Should it pass Congregation, it will be submitted to Convocation, upon the decision of which depends its ultimate destiny. The date of the final struggle has not yet been made public, but it is practically certain that the present term will see the close of the long controversy.

THE board of trustees of Stanford University has announced, says *Science*, a gift of 2000*l.* made by Prof. Adolph Barkan, San Francisco, professor emeritus of the medical school, for the establishment of a special library dealing with diseases of the eye, ear, nose, and throat. A gift of 1000*l.* from Charles C. Stanford for medical library purposes is also announced.

AT the meeting of the council of the Royal Agricultural Society, held on October 25, the Duke of Devonshire reported the special committee's recommendation that the society's gold medal should be offered for original research on any agricultural subject or any of the cognate agricultural sciences. The medal will be awarded for a monograph or essay giving evidence of original research, and candidates must reside in Great Britain or Ireland, and must not be over the age of twenty-seven years or of more than five years' standing from the time of taking their first agricultural qualification, the qualification being a degree or diploma of a university or university college, or the National Diploma in Agriculture.

WE learn from *The British Medical Journal* that a new university has been founded by the United States in the Philippine Islands. There was already a University of St. Thomas, founded by the Spaniards in 1611, but it was thought that this old institution did not meet modern requirements. The new university comprises a college of medicine and surgery, which was opened in 1907, besides colleges of veterinary science, of agriculture, of the liberal arts, of law and political science, and of engineering. The seat of the new university is Manila. A clause of the Act founding the university is to the following effect:—"No student shall be denied admission to the university by reason of age, sex, nationality, religious belief, or political affiliation."

THE annual meeting of the Association of Teachers in Technical Institutions will be held at the Borough Polytechnic, Borough Road, S.E., on Saturday, November 4, the president, Mr. Barker North, in the chair. The annual report of the council, which will be considered at this meeting, deals with the large increase in the membership of the association in the past year, and with active work during that period. Branches have been formed in Ireland and Wales, so that the activities of the association now spread over the whole kingdom. After the consideration of the report a discussion will be initiated on the Board of Education examinations in science, by Mr. C. F. Smith, Manchester School of Technology, and Mr. J. Wilson, Battersea Polytechnic. To this discussion visitors are invited. Particulars can be obtained from the honorary secretary, Mr. P. Abbott, The Polytechnic, Regent Street, W.

THE Association for the International Interchange of Students is a body which exists to promote the intelligent study of other countries by the university students of Great Britain and the colonies. The organisation arranges tours during which students are brought into contact with the leading cities and citizens abroad, and are thus enabled to study at first hand the social, political, municipal, and university life of other countries. The first annual report contains reports of speeches made by some of the students who have availed themselves of the advantages the association offers, and gives ample evidence of the value of the movement. In addition to putting any class of student in touch with the best sources of information, the secretary, Mr. W. H. Crees, has succeeded in modifying the expenses of travel. Unfortunately, like many other institutions, the association has suffered from lack of funds, and is unable to carry out the proposal of travelling scholarships which were first of all contemplated.

THE Imperial Conference of Teachers' Associations convened by the League of the Empire is to be held on July 12–16, 1912. The list of agenda includes a variety of subjects, such as the training of teachers (professional and university); the recognition throughout the Empire of teachers' certificates; the migration of teachers for purposes of study generally and for temporary interchange of appointments; coordination in education; and the working of the scholarship system in different parts of the Empire. Besides these subjects, technical education in its relation to local industries and as a preparation for general scientific and trade research; the place of history and geography in education; the English language and literature; and physical education, will form subjects of discussion. Overseas teachers in particular will consider the best means of organising a rural school. Suggestions are constantly being received from overseas teachers' associations. It has been proposed to illustrate the agenda with observation work, and illustrated lectures will be introduced both before and after the conference. A short course of travel-study in England is also being prepared.

A COPY of the first volume of the calendar for 1911–12 of the University of Sheffield has been received. It contains full particulars concerning all the courses of work in the various faculties and the conditions under which the different degrees of the University are conferred. The arrangements in the faculty of applied science are of especial interest. These departments provide lecture and laboratory courses of instruction in the subjects of applied science required in the engineering, metallurgical, mining, and building industries. Students are in certain circumstances permitted to qualify for degrees in part by evening study. For example, students employed during the day in some metallurgical works or laboratory approved by the faculty are permitted to qualify in part by evening study for the degree of Bachelor of Metallurgy. We notice, too, that the council of the Institution of Civil Engineers recognises, under certain conditions, the degree of Bachelor of Engineering of this University as exempting from the institution's examination for associate membership. An arrangement has been made also with the Imperial College of Science and Technology by which the University of Sheffield is recognised as being in association with the Imperial College for such of their students as may desire to specialise in the study of the metallurgy of iron and steel for the associateship of the Royal School of Mines.

THE new laboratories at Shrewsbury School were formally opened on October 20 by Mr. Francis Darwin, F.R.S., who gave an address in the school hall, Lord Barnard presiding as chairman of the governing body. In order to emphasise the present attitude of the school towards science, Mr. F. Darwin repeated the well-known story of his father as a Shrewsbury boy being publicly rebuked by Dr. Butler, the headmaster, for wasting his time in the study of chemistry at home in an improvised laboratory. The contrast between this state of things and the present curriculum, in which every boy in the school has to go through a course of practical scientific training, is sufficiently striking. The need for new laboratories is due to the prominence given to science by the headmaster, Mr. Alington, and at the present time 270 boys are passing through the science school under the guidance of five masters. The recent additions, which have been named the Darwin Buildings, consist of three rooms, two for physics and chemistry, respectively, and the third for nature-study and physical measurements, and all are excellently fitted for their various purposes. At the end of his address Mr. F. Darwin pointed out that the method adopted in the science school at Shrewsbury is in harmony with the motto of the Royal Society, *Nullius in verba*, since the essence of laboratory work is that the pupil learns by observation and experiment rather than from the assertions of his teacher.

DR. ALFRED MUMFORD, in his annual report as medical officer to the governors of the Manchester Grammar School, states that he has been able to compare the physical development during the last five years (*i.e.* since the influence of the presentation of free scholarships to boys from the elementary schools has become felt) with the physical development of the boys of a generation ago, viz. during the period of 1881–6. He finds there has been a remarkable gain in nearly all directions, especially as regards height and weight, amounting to more than 1 inch in height between the ages of thirteen and sixteen,

and to an average increase of more than 4 lb. in weight. At the age of sixteen the boys are $1\frac{1}{2}$ inches taller and 8 lb. heavier than a generation ago. The improvement is less marked at seventeen and eighteen years of age, and disappears in those who stay until nineteen. These calculations are based on more than 6000 measurements. This remarkable change probably has many causes, chief among them being the steady diminution or postponement of early infectious disease in childhood, due to the progressive operation of the Public Health Act of 1875. A second factor of equal, if not greater, importance has been the changed attitude towards athletics and physical exercise, particularly during the younger ages, that prevails throughout the school to-day. Other causes of the general improvement in physique are the better housing, the increased knowledge and better use of foods, and the greater insight into the meaning of parental responsibility as regards health, which are certainly affecting a considerable number of homes at the present day. In order to test the question as to whether the free scholars—two-thirds of whom come from the elementary schools—are of inferior physique to their companions, comparisons, based on 250 cases, were made between the two at successive years of life, and it is found that, though the "free scholar" is slightly smaller at eleven, twelve, and thirteen, yet by the age of fourteen he has equalled his companions in height, and in some cases surpassed them.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, October 18.—Mr. H. G. Plimmer, F.R.S., president, in the chair.—T. W. **Butcher**: Structural details of *Coscinodiscus asteromphalus*. A paper describing the primary areolations with the secondary and tertiary markings, illustrated by a series of lantern-slides made from photomicrographs obtained at a magnification of 1100. In addition, slides were shown demonstrating a fine siliceous network, or veil, lying upon the outer surface of the valve, and others in series, from photomicrographs taken, at 5 or 6 consecutive foci, of the hexagonal cell layer with its "ringed" openings of Morland, to prove that these openings are clear and not obstructed by the finely perforated membrane recently reported by Mr. Nelson (Journ. Roy. Micro. Soc., October, 1910). The membrane being non-existent, its value as a test for a high-power lens is *nil*.—Rev. Hilderic **Friend**: New British enchytræids. *Enchytraeus minimus*, Bret., was described in the *Rev. Suisse de Zoologie* in 1899. Michaelson in *Das Tierreich*, 1900, suggested that it might be one with *E. argenteus*, Mich. (=*E. parvulus*, Friend). Bretscher examined the subject again in 1902, and decided that the two were distinct. The author, who had already described *E. argenteus*, has found *E. minimus* at Buxton, and holds with Bretsche. *Fridericia peruviana*, n.sp., was received in earth from Peru, and submitted to the author by the authorities at Kew. It is 5–6 mm. in length, and has two to five setæ, which are somewhat larger behind than before. Brain slightly concave posteriorly; œsophagus sharply marked off from intestine; dorsal vessel postclitellian in origin, with dilatations in segs. 7–9. Salivary glands not branched; long.—Walter **Bagshaw**: Instantaneous exposure in photomicrography. Flashlight illumination has been put to a novel use by Mr. Bagshaw for the photography through the microscope of objects in motion. A good negative of fresh-water polyzoa (*Lophopus crystallinus*) expanding its tentacles was secured by a charge of "Agfa Flashlight Powder" in one-thirtieth of a second. Gatherings of pond life, such as diatoms, larvæ, water fleas, also yielded successful results. Provision was made for replacing the ordinary lamp by flash powder put in the position previously occupied by the centre of flame, and ignition made with a red-hot wire.

MANCHESTER.

Literary and Philosophical Society, October 17.—Prof. F. E. Weiss, president, in the chair.—H. J. **Woodall**: Mersenne's numbers. In 1644 Mersenne published a book entitled "Cogitata Physico-Mathematica," in which it was stated that certain numbers obtained by raising 2 to the power p, where p is a prime number not greater than 257, and subtracting unity from the result, would be factorisable except in twelve specified instances. He left no clue as to how he arrived at this result, nor is any method known by which he could have done so. Subsequent examination has shown that the statement is incorrect in two cases, one case being prime where he said composite, and the other the reverse, but most of those which, according to him, are factorisable, have been proved to be so. Mr. Woodall gave a proof that the number obtained by subtracting unity from the 181st power of 2 is divisible by 43,441, the quotient containing fifty figures. He explained the method by which the divisor had been arrived at, and stated that the number of unproved cases is now reduced to sixteen (fifteen composites and one prime) out of a total of fifty-six.—S. **Hirst**: A collection of Arachnida and Chilopoda made by Mr. S. A. Neave in Rhodesia north of the Zambezi. The paper deals with the scorpions, Pedipalpi, Solifugæ, and centipedes collected by Mr. Neave. Four new species are described, two of which were obtained by Mr. Neave, the remaining two being specimens in the British Museum, that were obtained from the same area. The new species present no features of special interest, differing only in certain details of the appendages from already known forms. Two of the species obtained by Mr. Neave had only been captured once previously, and are thus of interest from this point of view.

PARIS.

Academy of Sciences, October 16.—M. Armand Gautier in the chair.—Ch. **Bouchard**: The velocity of parachutes. A certain time after starting a parachute the velocity becomes uniform, and this velocity depends on the ratio of P, the weight, and S, the horizontal projection, of the carrying surface. The application of the ordinary resistance formula for air, in which the resistance depends on the square of the velocity, to these measurements, gave unsatisfactory results, but a formula involving the square root of the cube of the velocity (V^3) was found to agree well with the experiments.—M. **Borrelly**: Observations of the Beljawsky comet (1911*g*) made with the comet finder at the Observatory of Marseilles. The positions are given for October 1 and 2. On October 1 the comet was very bright, and visible to the naked eye. The tail was well marked, and extended about 15° from the nucleus. On the following day the appearance of the comet had completely changed, the nucleus being surrounded by a circular halo, two aigrettes showing on the right and left.—M. **Nicolau**: The variation in the movement of the moon.—A. **Demoulin**: The R and ν surfaces.—Etienne **Delassus**: The non-linear linkages and the movements studied by M. Appell.—Marcel **Brillouin**: An interferential method for the determination of the moduli of torsion of crystals. The deformation of the surface of a crystal plate under flexion can be studied by means of the interference fringes, the measurements being made with a metallographic microscope under a low magnifying power. It is shown that all the moduli can be calculated from such measurements.—Georges **Claude**: The volatilisation of the electrodes in neon tubes. It has been shown in a previous note that the gases obtained by the treatment with nitric acid of the film of volatilised metal contain, besides neon, a considerable proportion of helium. Three hypotheses may be put forward to account for this fact: the possible selective action of the volatilised metal on helium contained in the neon in a proportion too small to be detected by the spectroscope, the transformation of neon into helium, or the possible transformation of a portion of the neon into compounds retained by the nitric acid. The experiments described in the present paper support the first of these hypotheses, the selective action of the metal, and this conclusion is in accord with the results of Ramsay and Collie arrived at in a different way.—A. **Rosenstiehl**: The theory of complementary colours.—P. **Janet**, F. **Laporte**, and R. **Jouaust**: The determination of the electromotive force in absolute measure of the normal Weston element. In an earlier publication the electromotive force of the Weston cell had been found by the authors to be 1·01869, in terms of the true ampere and the international ohm. Comparison of the ohm used with those of foreign laboratories reduces this figure to 1·01859,

and a recalculation of the constants of the electrodynamometer used causes a further reduction to 1·01836 (at 20° C.), a value only slightly higher than values obtained in other laboratories.—Albert **Colson**: The theory of solutions. An adverse criticism of the van 't Hoff-Arrhenius theory of solutions.—L. **Gay**: The expansibility pressure of a normal fluid.—Marcel **Delépine**: The volatility of sulphur compounds. Many examples are known in which the replacement of oxygen in a compound by sulphur causes a lowering of the boiling point, and there is a general impression that this is always the case. The author suggests that the substitution of sulphur for oxygen always raises the boiling point of a compound, except in the case of the hydroxyl group of water and the lower alcohols, phenols, and acids.—Henri **Martin**: A human skeleton found in Charente (see p. 16).—R. **Lacasse** and A. **Magnan**: A bicephalous human monster.—Louis **Roule**: Some larvæ of apodal fishes.—R. **Koehler**: Antarctic echinoderms arising from the expedition of the *Pourquoi-Pas?*—Henry **Hubert**: An attempt at a geological map of western Africa.—Ch. **Moureu** and A. **Lepape**: The spectrophotometric estimation of xenon. Constancy of the xenon-argon and xenon-krypton ratios in natural gaseous mixtures. The basis of the method is the increase of intensity of the blue indigo xenon line 4671·4 when the proportion of xenon is increased in a mixture of xenon and argon.—M. de Montessus **de Ballore**: The application of the Cardan suspension to seismographs.

October 23.—M. Armand Gautier in the chair.—Remarks by the president on the work of De Romas, whose statue has just been erected at Nérac.—A. **Müntz** and E. **Laine**: The ammonia in the rain and snow at the observation stations of the Charcot expedition. The estimation of ammonia in eighteen specimens of snow and rain water showed that the distribution of ammonia in rain and snow in the Antarctic regions does not greatly differ from the amounts found at European stations.—Ch. **André**: The cosmogony of Laplace. A criticism of some calculations published by T. J. J. See adverse to the theory of Laplace. The author holds these conclusions to be untenable.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1911. Observations were possible on sixty-nine days. The results are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—J. **Bosler**: The spectrum of Brooks's comet. Three negatives were taken with exposures of twenty-five minutes, one hour, and one hour thirty-five minutes, the comparison spectrum employed being that of Vega. Besides the hydrocarbon and cyanogen bands there was a group of lines of wave-lengths 407, 405, 401, and 399. The spectrum of the tail was quite different from that of the head, and resembles the spectrum of the tail of the Daniel comet.—M. **Iniguez**: Observations of the Brooks comet made at the Observatory of Madrid.—Henri **Villat**: Certain integral equations of a new type and some problems relating to them.—E. **Jouguet**: The dynamical adiabatic law in the motion of wires.—Georges **Claude**: The commercial manufacture of pure nitrogen. In the preparation of calcium cyanamide by the action of nitrogen upon calcium carbide at a high temperature a very pure nitrogen is required. The quantities required on the large scale are such that chemical methods of preparation are out of the question, and the present paper gives an account of the method of preparing nitrogen by the fractional distillation of liquid air. It is necessary that the nitrogen produced should contain less than 0·25 per cent. of oxygen. Three installations of the type described in the paper have been set up, giving nitrogen of a purity of 99·7 to 99·8 per cent.—Jean **Villey**: The electric couple in electrometers.—Eugène **Fouard**: The osmometry of saline solutions and the ionic theory of Arrhenius. An account of experiments made with a differential osmometer against saccharose as a standard. The results with potassium sulphate are in accord with the Arrhenius theory; with potassium chloride, copper sulphate, and barium chloride, on the other hand, the results found are opposed to the ionic theory.—G. **Darzens** and H. **Rost**: The syntheses of some new hydroaromatic ketones. The chloride of the hydroaromatic acid is prepared by the action of $SOCl_2$, and this, diluted with ether, is treated with the organo-magnesium compound at a temperature of −10° C. The ketone, which is mixed with a small quantity of tertiary alcohol, is purified by conversion into the semicarbazone; the yields are good, from 40 to 60 per cent. Details are given of the preparation and properties of several ketones.—M. **Marage**: Various kinds of deaf-mutes.—Ch. **Gravier**: Some biological peculiarities of the annelid fauna of the Antarctic seas.—E. **Roubaud**: The evolution and history of the "Ver du Cayor," an African larva from the skin of *Cordylobia anthropophaga*.—Maurice **Piettre**: The melanic pigments of animal origin. The pigment was isolated from material from the horse, avoiding the use of strong acids or alkalis in the separation. Analyses of the pigment are given and of the substance derived from it by hydrolysis.—Stanislas **Meunier**: The chemical and lithological examination of the El Nakhla meteorite. This meteorite belongs to a new type allied to Chladnite, from which it differs by the substitution of hypersthene for eustatite.—J. **Thoulet**: The fall of sediments in oceanic waters.

MELBOURNE.

Royal Society of Victoria, September 14.—Prof. E. W. Skeats in the chair.—E. F. J. **Love** and G. **Smeal**: The psychrometrical formula. A modified formula for the wet- and dry-bulb hygrometer was suggested by Ekholm in 1908, viz. $x=\eta f-AB(t-t')$, where η is a proper fraction to allow for diminution of vapour pressure by hygroscopic action of the material on the wet bulb. The facts do not require any such interpretation, and the formula is tested by observations with several wet bulbs covered with different materials. A new large type of screen was used, and simultaneous readings show no difference to temperature, as would be the case if such action occurred; further, by comparison with a Regnault hygrometer, the value of η is found by least squares to be unity, confirming the usual theory.—Howard **Ashton**: Some new Australian Cicadidæ. The specimens come from northern Australia. The following are new:—*Cyclochila laticosta*, *Psaltoda pulchra*, *P. fumipennis*, *Macrotristria doddi*, *Owra insignis* (n.g. et n.sp.), *Thaumastopsaltria glauca*, *Melampsalta brevis*, *M. viridis*, *M. crucifera*, *Pauropsalta elgneri*, *P. subolivacea*, and *Prasia vitticollis*.—Prof. **Skeats**: Specimens from Heathcote showing all stages of metasomatism from diabase to quartz.—T. S. **Hall**: Graptolites from Preservation Inlet, west coast of New Zealand. These are of Lancefieldian (lowest Ordovician) age; Bryograptus, Clonograptus, and other genera are present. A most remarkable fact was the exact lithological resemblance of the rock, a blue-black silicified shale, to that of Lancefield (Victoria), though the localities are some 1200 miles apart.

BOOKS RECEIVED.

Monopoly and Competition: a Study in English Industrial Organisation. By Prof. H. Levy. Pp. xviii+333. (London: Macmillan and Co., Ltd.) 10*s*. net.

Essays and Clinical Studies. By Dr. F. G. Crookshank. Pp. 245. (London: H. K. Lewis.) 7*s*. 6*d*. net.

Experiments in Organic Chemistry. By Dr. F. J. Moore. Pp. vi+27. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd.) 2*s*. net.

The Art of Life: the Way to Health and Longevity. By Prof. Jogender Lal Chundra. With an introduction by Lieut.-Colonel R. L. Dutt. Pp. ii+240. (Calcutta.) 3*s*. net.

Allen's Commercial Organic Analysis. A Treatise on the Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, &c., with Concise Methods for the Detection and Estimation of their Impurities, Adulterations, and Products of Decomposition. Edited by W. A. Davis and S. S. Sadtler. Vol. v. Fourth edition. Entirely rewritten. Pp. ix+704. (London: J. and A. Churchill.) 21*s*. net.

La Fécondation chimique (Parthénogenèse artificielle). By J. Loeb. Édition Française by Dr. A. Drzewina. Revue et augmentée par l'Auteur. Pp. x+366. (Paris: Mercure de France.) 5 francs.

Types of British Vegetation. By members of the

Central Committee for the Survey and Study of British Vegetation. Edited by A. G. Tansley. Pp. xx+416. (Cambridge University Press.) 6s. net.

First Book of Zoology. By T. H. Burlend. Pp. viii+159. (London: Macmillan and Co., Ltd.) 1s. 6d.

Macmillan's Reform Arithmetic. By P. Wilkinson and F. W. Cook. Book VI. Pp. 64. (London: Macmillan and Co., Ltd.) 4d.

Géologie du Bassin de Paris. By M. P. Lemoine. Pp. vi+408. (Paris: A. Hermann & Fils.) 15 francs.

Third Report on the Experimental Work of the Sugar Experiment Station for the Years 1908, 1909, and 1910, Jamaica. By H. H. Cousins. Pp. 135. (Kingston, Jamaica: Hope.)

Nouvelles Tables Trigonométriques Fondamentales (Logarithmes). By Prof. H. Andoyer. Pp. xxxii+603. (Paris: A. Hermann & Fils.) 30 francs.

The Natural History and Antiquities of Selborne in the County of Southampton. By Gilbert White. With illustrations in colour by G. E. Collins. Pp. x+476. (London: Macmillan and Co., Ltd.) 10s. 6d. net.

Die Wirbeltiere. By Prof. O. Jaekel. Pp. viii+252. (Berlin: Gebrüder Borntraeger.) 10.60 marks.

Petits Contes Populaires. Adapted and edited with exercises by F. B. Kirkman. Pp. 52. (London: A. and C. Black.) 8d.

Wörterbuch der I ologie. By Dr. H. Schmidt. Pp. viii+581. (Leipzig: . Kröner.) 10 marks.

L'Assaut du Pol Sud. By l'Abbé Th. Moreux. Pp. 221 (Paris: Jouv & Cie.) 1.50 francs.

Life in the Sea. By J. Johnstone. Pp. vii+150. (Cambridge University Press.) 1s. net.

New Zealand. By the Hon. Sir R. Stout and J. L. Stout. Pp. viii+185. (Cambridge University Press.) 1s. net.

Steam Turbine Design, with Special Reference to the Reaction Type, including Chapters on Condensers and Propeller Design. By Dr. J. Morrow. Pp. viii+471. (London: Edward Arnold.) 16s. net.

The Adventures of Jack Rabbit. By R. Kearton. Pp. xii+248. (London: Cassell and Co., Ltd.) 6s.

The Story of the Five Elements. By E. W. Edmunds and J. B. Hoblyn. Pp. viii+264. (London: Cassell and Co., Ltd.) 2s. 6d. net.

Ostwald's Klassiker der Exakten Wissenschaften, No. 179. Abhandlungen über Dialyse (Kolloide). By Th. Graham. Herausgegeben von E. Jordis. Pp. 179. (Leipzig: Engelmann.) 3 marks.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 2.

ROYAL SOCIETY, at 4.30.—Colour Blindness and the Trichromatic Theory of Colour Vision. Part III. Incomplete Colour Blindness: Sir W. de W. Abney, K.C.B., F.R.S.—Note on the Iridescent Colours of Birds and Insects: A. Mallock, F.R.S.—The Behaviour of the Infusorian Micronucleus in Regeneration: K. R. Lewin.—An Inquiry into the Influence of the Constituents of a Bacterial Emulsion on the Opsonic Index: A. F. Hayden and W. P. Morgan.—The Morphology of *Trypanosoma gambiense* (Dutton and Todd): Colonel Sir David Bruce, C.B., F.R.S.—(1) Factors in the Interpretation of the Inhibitive and Fixation Serum Reactions in Pulmonary Tuberculosis; (2) Preliminary Report upon the Injection of Rabbits with Protein-free (Tuberculo-) Antigen and Antigen-Serum Mixtures: A. H. Caulfeild.

MONDAY, NOVEMBER 6.

SOCIETY OF ENGINEERS, at 7.30.—Two-cycle Engines: R. W. A. Brewer.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Norsemen in America: Dr. Fridtjof Nansen, G.C.M.C.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Deflocculation as Affecting Lubrication: Dr. E. G. Acheson.

TUESDAY, NOVEMBER 7.

INSTITUTION OF CIVIL ENGINEERS, at 8.—President's Address.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: Alan A. Campbell Swinton.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern Exhibition on the Moulting of the Arctic Fox: R. I. Pocock, F.R.S.—On the Moulting of the King's Penguin (*Aptenodytes pennanti*) in the Society's Gardens: D. Seth-Smith.—On the Presence of Two Ovaries in Certain British Birds, more especially the Falconidæ: T. E. Gunn.—Ontogenetical Transformations of the Bill in *Ardea cinerea*: Prof. P. P. Sushkin.—On some Collembola from India, Burma, and Ceylon, with a Catalogue of the Oriental Species of the Order: Dr. A. D. Imms.

WEDNESDAY, NOVEMBER 8.

FARADAY SOCIETY, at 8.—Address by Dr. E. G. Acheson.

GEOLOGICAL SOCIETY, at 8.—On the Interglacial Gravel-Beds of the Isle of Wight and the South of England, and the Conditions of their Formation: Prof. E. Hull, F.R.S.; The Gopeng Beds of Kinta, Federated Malay States: J. B. Scrivenor.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Some Problems in the Dye n and Finishing of Silk Fabrics: W. P. Dreaper.

THURSDAY, NOVEMBER 9.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Modern High Voltag Power Transformers in Practice with special reference to a "T" Thre Unit System: W. T. Taylor.

THE CONCRETE INSTITUTE, at 8.—Presidential Address: Sir Hen Tanner, C.B.

ROYAL SOCIETY, at 4.30.—*Probable Papers*—The Spectrum of Boron: Si W. Crookes, O.M., For. Sec. R.S.—A Chemically-active Modification Nitrogen produced by the Electric Discharge. II.: Hon. R. J. Strut F.R.S.—Production of Solid Oxygen by the Evaporation of the Liquid Prof. Sir J. Dewar, F.R.S.—On the Gaseous Condensable Compound Explosive at Low Temperatures, produced from Carbon Disulphid Vapour by the Action of the Silent Electric Discharge. II.: Prof. Sir J Dewar, F.R.S., and Dr. H. O. Jones.—(1) Optical Dispersion: A Com parison of the Maxima of Absorption and Selective Reflection for certa Substances; (2) The Influence of the Solvent on the Position of Absor tion Bands in Solutions: Dr. T. H. Havelock.—An Experimental Invest gation of Gibbs's Thermodynamical Theory of Interfacial Concentration i the Case of an Air-water Interface: Prof. F. G. Donnan, F.R.S., an J. T. Barker.

LONDON MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Invariants of the Linear Partial Differential Equation of the Secon Order in Two Independent Variables: J. E. Campbell.—On Invariants c a Canonical Substitution: H. Hilton.—The System of Lines of a Cub Surface: C. T. Bennett.—The Relations between Borel's and Cesaro Methods of Summation: G. H. Hardy and J. E. Littlewood.—A Metho of Establishing the 27-line Configuration of a Cubic Surface: W. P. Miln Mathematical Analogues of Mental Phenomena: H. Bateman.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY (at Finsbury Technical College) at 5.—Reflectin Polariscopes for the Study of Optical Stress in Materials: Prof. Silvanus Thompson and Prof. E. G. Coker; The Effects of Holes and Semicircula Notches in the Distribution of Stress in Tension Members (demonstrate by polarised light): Prof. E. G. Coker.—(1) A Surface-tension Phen menon; (2) Temperature Rise in Drops as they Part; (3) Temperature of Equidensity of Liquids: Mr. C. R. Darling.—(1) Exhibition of a Larg Harmonograph; (2) Physiological Effect of an Alternating Magnet Field; (3) Demonstrations of Acoustical Experiments. New and Old Prof. S. P. Thompson.

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THURSDAY, NOVEMBER 9, 1911.

TIDAL ACTION AND COSMOGONY.

The Tides and Kindred Phenomena in the Solar System. The substance of lectures delivered in 1897 at the Lowell Institute, Boston, Massachusetts, by Sir G. H. Darwin, K.C.B. Third edition. Pp. xxiv+437. (London: John Murray, 1911.) Price 7*s.* 6*d.* net.

THE first edition of this book appeared in 1898, and was reviewed in NATURE, vol. lix., p. 219. The work has since taken rank as a classic in its way, and has been translated into several languages. There is no need, therefore, to dwell at any length on its general character and purpose. It aims at giving, with as few technicalities as possible, a summary of the researches on tidal theory, and more especially on the theory of tidal evolution, which have been the principal occupation of the author's long scientific career. It would be misleading to describe it merely as a "popular" book, for it is a valuable guide even to experts who might otherwise be dismayed by the long and intricate calculations in which the original investigations necessarily abound. In this respect it may perhaps be compared with the celebrated "Exposition du Système du Monde" which Laplace added as a supplement to the detailed work of the "Mécanique Céleste." It is true that the subject-matter is in the present case more speculative, but the purpose is the same, and the execution not unworthy of the great exemplar.

In this third edition some additions and alterations have, however, been made which call for notice. These consist in part of supplementary notes to the earlier chapters, in which brief summaries are given of recent work bearing on the various topics. Thus at the end of the first chapter there is an interesting account of deep-sea tide gauges, with a tantalising indication of the valuable results which might be obtained if an extended and systematic use of such appliances were practicable. The appreciative account of Forel's early investigations of the "seiches" of the Lake of Geneva is appropriately supplemented by a reference to Chrystal's recent work on the Scottish lochs. The remarkable observations of Dr. Hecker on the lunar disturbance of gravity, which are the successful realisation of an interprise in which Sir G. Darwin himself led the way, are described with generous enthusiasm. In the absence of any authoritative account in English of these experiments, it is perhaps to be regretted that the description is not still more ample. Their value consists, of course, in the inferences which they justify as to the degree of rigidity of the earth. The other lines of evidence bearing on the same question, viz. those based on observations of the fortnightly tide, and on the free (Eulerian) nutation of the earth's axis, are also explained and discussed, the general conclusion being that the earth's surface yields, under the action of tidal or precessional force, about two-fifths as much as if it were absolutely devoid of rigidity. The more recent work of Love and Larmor, in which a greater degree of precision is given to the inferences which can be drawn from the respective lines of argument, was probably judged to be of too refined a character to admit of elementary treatment.

The views of the author as to the age of the earth, and the scale of geological time, have, as explained in this edition, undergone considerable modification. In 1898 the arguments of Lord Kelvin, which assigned a comparatively moderate age to the solid earth, were in the ascendant; but the rapid and startling succession of discoveries in radio-activity have undermined much of the reasoning based on such considerations as the output of energy from the sun and the secular cooling of the earth. Moreover, the researches of Strutt claim positively to demonstrate an enormous antiquity for certain rocks, far transcending the limits formerly accepted by physicists. On the other hand, an altogether independent estimate by Joly, based on a comparison of the amount of sodium in the ocean with the amount annually carried into it by rivers, would give to the existing ocean an age of about 100 million years at most, a figure which is on the scale of Kelvin's results. The discrepancy is at present unexplained, but we may note an interesting essay on the subject by Joly, in a recent number of the *Phil. Mag.* (September, 1911). Sir G. Darwin inclines, on a review of the whole evidence, to the belief that there is no assignable limit to the fund of time on which biologists may draw for the purpose of their evolutionary theories.

The last three chapters of the book are almost altogether new. The first of these is devoted to a general explanation of the theory of "figures of equilibrium" of rotating fluid, a classical problem with which the names of Maclaurin, Jacobi, Roche, Poincaré, and Darwin will always be associated. The theory of the stability of the various forms is of too technical a character to admit of really elementary treatment, but the summary will be welcome even to mathematicians, as a survey of a somewhat intricate subject. The succeeding chapter, one of the most fascinating in the book, gives a striking application of the theory to the phenomena of variable stars. The evolution of binary stars, a very attractive subject, is also considered, but the intricacy of such speculations is exemplified by the fact that a new source of instability, known as "gravitational instability," comes into play in the case of a gaseous mass. The concluding chapter treats of the nebular hypothesis of Laplace, and of the more important modifications of it which have been proposed by subsequent writers. In particular the "planetesimal" hypothesis of Chamberlin and Moulton, which was suggested by the observed prevalent spiral configuration of many nebulæ, is discussed at some length. Some speculations have an invincible attraction for the mind, but the critical reader will have an uneasy feeling that here at any rate he is making doubtful ventures into a mysterious region, far away from any secure dynamical base.

It would be wrong to end this notice without a word of admiration for the modesty and restraint which the author has shown in setting forth the results of speculations in the origin and development of which he has himself borne a predominant part.

The results of theoretical reasoning are always stated with scrupulous care, and their limitations clearly expressed, and no attempt is made to press conclusions based on idealised premises further than the case will warrant. A striking instance of this is furnished by the way in which, after developing his theory of the evolution of the earth-moon system with justifiable enthusiasm and evident faith, he takes care frankly to point out that other agencies must probably be sought to account for the origin of the satellites of the exterior planets and of the planets themselves.

H. L.

RECENT ADVANCES IN THE GENETICS OF PLANTS.

Einführung in die experimentelle Vererbungslehre By Prof. E. Baur. Pp. vi+293. (Berlin: Gebrüder Borntraeger, 1911.) Price 8.50 marks.

PROF. ERWIN BAUR is well known to students of genetics as a most successful investigator. The fifteen lectures included in the present volume were delivered as a course in Berlin, and they constitute an admirable text-book of the subject, which will do much to familiarise Continental biologists with the methods of Mendelian analysis and the deductions to which it has led. The coloured pictures are exceptionally good. No clearer or better illustrated account of the present state of knowledge of these matters could be desired.

Some years ago Prof. Baur began a series of researches into the nature of variegation in plants, without any special intention of investigating Mendelian phenomena, but, like so many others engaged on special problems, he soon found that a knowledge of heredity was indispensable to a proper understanding of his subject. The breeding experiments then instituted, though begun as a side-issue, have illuminated the whole field. His first success was obtained in a study of the golden-leaved Antirrhinum, which he proved to be a heterozygous form, possessing only one factor for greenness. Self-fertilised, it gives two yellows to one green, the missing term in the series being the homozygous albinos which perish on germination.

This led to a comprehensive examination of the inheritance of flower-colour in *A. majus*, a subject also studied by Miss Wheldale in this country. The series of types is very large, seeming at first sight almost continuous, and the analysis was exceptionally troublesome, but it is satisfactory to know that though working independently, both observers have arrived at practically the same conclusions as to the factorial composition of the several forms. In this book Antirrhinum is naturally taken as the typical example of the effects of combinations of long series of factors, and the reader who masters this example will have encountered most of the complications which ordinary Mendelian inheritance presents.

From this work on the varieties of a single species Baur has gone on to less familiar ground, and in this book he gives the first results of his experiments on the interrelation of forms which are quite distinct species in the systematic sense, especially *A. majus* and *A. molle*. The F_1 plants are fully fertile, and F_2 shows a long series of diverse types resulting from the recombination of segregating factors, but the analysis is still to be completed. One observation of extraordinary interest is announced, namely, that the self-sterility of *A. molle* is a recessive. This announcement must be regarded as preliminary, but if established, the discovery will constitute a striking advance. Self-sterility is one of the greatest paradoxes in nature. If it is true, as we are almost forced to believe, that a self-sterile plant can be fertilised by the pollen of *any* other individual but not by its own, then each individual is differentiated by virtue of its individuality, and there are as many classes as individuals. The notion once suggested by de Vries, which I also had formerly entertained, that there are in reality several *classes* of individuals and that probably fertilisation was inoperative only within each class, is negatived by such experiments as have been made by others and by myself (on a small scale in *Linaria vulgaris*). If self-fertility be a dominant, the main mystery is still unsolved, but we have a new fact of great consequence which may lead to a solution.

The most important chapters are those in which Baur describes his discoveries regarding the inheritance of the several forms of "Chimæra," the term Winkler has introduced to denote patchwork or mosaic individuals. In a variegated Pelargonium, for instance, the albino parts of the vegetative organs may be *sectorial* forming radiating patches of white, or *periclinal*, in which case the external layers of cells may be green and the internal white; or conversely the internal may be green and the external cells white. Baur has shown that the colour of the offspring, whether green or white, depends on the nature of the subepidermal layer of cells from which the parental germ-cells were derived. If in the periclinal chimæra the two peripheral layers of cells are green, the offspring (of self-fertilisation) are all green; if the peripheral layers are albino the offspring are all albino, and, of course, perish. If only the outer cell-layer is white the offspring are green. In either case the particoloured character does not reappear in the offspring. From the sectorial chimæras the inheritance is more complex, and much remains to be cleared up. This discovery of the significance of the subepidermal layer is one of very great importance, and we may anticipate that it will lead to remarkable extensions. It may not improbably lead to a reconsideration of the generally accepted doctrine that segregation takes place in gametogenesis.

Baur has applied these observations to the interpretation of the curious "graft-hybrids" between *Solanum nigrum* and the tomato, first made by Winkler. Some of these were obviously sectorial patchworks of the two species, but Baur suggested that of the others some were actual periclinal chimæras, in which a foundation of tomato was enclosed in one or in two cell-layers of *S. nigrum*, or conversely *S. nigrum* enclosed in an outer sheath of tomato tissue. This conclusion was at first strongly resisted by Winkler, but in a preliminary communication he has since announced the proof that it is correct, having himself by cytological investigation of the growing

points of the periclinal forms been able to prove that some of the layers have the chromosome numbers proper to *S. nigrum*, and others those of *Lycopersicum*. We can scarcely doubt that this remarkable series of observations will pass into the classics of biology.

On similar lines Baur proposes to elucidate the old problem of *Cytisus Adami* and *Crataego-mespilus*, the two traditional examples of "graft-hybrids." The former, for instance, is regarded as a Laburnum enclosed in a sheath of *C. purpureus*. On occasion, as when the exterior is wounded, the Laburnum can come out and develop. Baur's idea is doubtless a part of the truth, but I cannot clearly apply it to all the phenomena which *Adami* presents, especially to the sexual vagaries which it shows in this country at least. In it the *Adami* flowers have good pollen but no good ovules; the *purpureus* flowers have the female parts developed, but the anthers bad; while the *Laburnum* flowers are perfect and set seed in plenty. Nor do I clearly understand the origin of the *purpureus* branches. One can scarcely help suspecting that in the segregation by which these phenomena are produced there is some complex repulsion between the sex-factors and the factors for colour or form, comparable with the distinctions now known to exist between the genetic constitution of pollen and ovules of the same individual in several cases, *e.g.* Stocks and Petunia (Miss Saunders), or Œnothera (de Vries).

The only point in this excellent book which calls for criticism is, in my judgment, the rather crude representation of segregation as effected by chromosomes. These pictures will live in the memory of the reader, and tend to limit his imagination of the possibilities more closely than the known facts at present warrant.

W. Bateson.

THE RUSTING OF IRON.

The Corrosion of Iron and Steel. By Dr. J. Newton Friend. Pp. xiv+300. (London: Longmans, Green, and Co., 1911.) Price 6*s.* net.

THE author gives a concise account of all the important work that has been carried out in connection with investigations relating to the causes of corrosion of iron and steel. The book is a model of its kind, since the references to original contributions to knowledge are exhaustive and will serve to direct the investigator to the literature of that branch of the subject in which he is specially interested. After dealing with the action of air, of water and of steam on iron, the various theories which have been advanced to explain corrosion are discussed, and the conclusion is drawn that "the most recent experimental results are entirely in favour of the acid theory of corrosion."

The action of acids and of alkalis, and the influence of solutions of salts of various kinds on iron are next considered, and a short chapter is then devoted to the action of oils on the metal. In dealing with the subject of the passivity of iron the author has failed to make clear the fact that the immersion of the metal in chromic acid must necessarily bring about the removal by oxidation of such impurities as manganese sulphide, which exist on the surface, and form acids on exposure to moist air. The metal by such treatment must in consequence be rendered more resistant to corrosion irrespective of any question of passivity. Nor is attention directed to the fact that the surface of iron immersed in chromic acid must necessarily remain bright whenever the acid is sufficiently concentrated to dissolve any rust which might be formed, and in this connection it may be noted that ferric hydroxide dissolves readily even in dilute solutions of chromic acid. Moreover, H. B. Baker and others have clearly shown that whatever properties are given to iron by immersion in dilute chromic acid immunity from rusting is not one of them, and it is extremely doubtful if previous immersion in chromic acid of any strength is a protection against atmospheric oxidation of iron.

The last three chapters of the book deal respectively with the influence of chemical composition on the corrodibility of iron, with electrical effects and with the relative rate of corrosion of iron and steel. The first of these might with advantage have been considered at an earlier stage—the author states that it is of paramount importance—since an explanation of that troublesome form of corrosion known as pitting in water-tube and other boilers must be sought mainly in the chemical composition of the iron of which they are made. The chapter on electrical action opens with the unfortunate statement that, "as is well known, when an electric current passes through water, the latter is readily split up into its constituent elements, oxygen and hydrogen." This erroneous inclusion of water amongst electrolytes may produce confusion in the minds of some readers, and is greatly to be regretted.

The book is well illustrated throughout, and will appeal to the general reader of scientific literature since it contains matters of interest apart from technical detail. For instance, an account is given of the Iron Pillar of Delhi, dating from 912 B.C., as an example of iron which has for centuries resisted atmospheric attack. There is, however, no record of the very rapid corrosion of the steel pipe line which conveys water from Mundaring to the Kalgoorlie Goldfield in Western Australia, and represents an outlay of upwards of 3,000,000*l.* sterling. Some account of the reports presented to the Government of Western Australia on this matter might with advantage have been cited, and the suggested treatment of the water by deaëration and liming, involving an expenditure for machinery of 187,000*l.*, discussed.

G. T. M.

ASPECTS OF THE EARTH'S STORY.

The Changeful Earth: an Introduction to the Record of the Rocks. (Readable Books in Natural Knowledge.) By Prof. G. A. J. Cole. Pp. x+223. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* 6*d.*

IT is refreshing to turn from the ordinary text-books of science—useful and necessary as such works undoubtedly are—to a booklet like that now before us. Science manuals in their efforts after inclusion and compression, in order to meet the wants of examination candidates, tend to become dogmatic in their

teachings, and the student is led to rely on the authority of the teacher rather than on any process of reasoning; of such works we must sadly confess "the trail of the examiner is over them all."

But for those who would learn to love geology for itself, Prof. Cole has supplied a charming, and at the same time trustworthy, introduction to the science. He has wisely adopted what may be called "the recapitulation method" of teaching, that is to say, he introduces new facts and ideas in the order and by the reasonings through which they were originally discovered, and by which the present position of the science has been gradually attained; knowledge is made to grow in the individual mind along the same lines as it can be shown to have done, though far more slowly, in the history of our race. It is needless to add that such a mode of presentation must be, to a great extent, biographical.

After some preliminary considerations, the author shows, in the first place, the steps by which William Smith, "the father of English geology," was led to his epoch-making discoveries of a stratigraphical succession, based on the evidence of fossils. Then turning from southern England to the Paris Basin, the labours of Lamarck and Deshayes, of Cuvier and Brongniart are indicated as affording useful aids to Charles Lyell in proving that, in the latest formed geological deposits, life-forms gradually replaced one another, thus lending support to the more general conclusion that the same continuity becomes manifest, as we trace the succession to the remotest past.

In succeeding chapters, the effects of running water, as taught by Hutton, and of moving ice, as shown by Agassiz, are well described, with illustrations drawn from the author's own observations and those of his contemporaries. "The Throat of a Volcano," "The Giant's Causeway," "The Making of Mountains," and "A Year of Earth Storms," are the headings of other chapters of this entertaining and instructive book, in which the labours of the pioneers of research are in all cases described with warm sympathy and just discrimination. The numerous illustrations of the book are, for the most part, from photographs taken by the author, and if any further evidence were needed that his descriptions are based on actual visits to the districts, it will be found in many a picturesque phrase. The hardest working college student, no less than the general reader, will find it an advantage to peruse this bright little book, for he can scarcely fail to catch some sparks of the enthusiasm of the author, which glows on every page.

J. W. J.

BANTU MYSTICISM.

Notes on West African Categories. By R. E. Dennett. Pp. xi+68. (London: Macmillan and Co., Ltd., 1911.) Price 1s. net.

IN this small book or enlarged pamphlet, Mr. R. E. Dennett recurs to his theories regarding formulæ, religious categories, and transcendental symbolism which he has believed himself able to trace in the employment of prefixes and word roots, more especially amongst the Bavili, a Congolese tribe of the Loango coast, and also in a lesser degree amongst the Yoruba and Bini peoples of the Niger Delta.

Mr. Dennett cannot fail to write interestingly on any African subject with which he is personally acquainted, since whether one agrees or not with his theories one is certain to find new and true facts in his compilations. But the reviewer is still quite unable to endorse from his own experience the probability that the Bavili (more especially) could have developed such an elaborate mathematical cosmogony and theology as Mr. Dennett places to their credit, and bases on the forms of their prefixes and of their word roots. As happens all too often, to the sorrow of the universal student of Bantu languages, Mr. Dennett has made a study of one particular Bantu dialect and deduces from his study theories which fall to pieces directly one compares that dialect with another of the same group, or one Bantu language with another. He strives to show that in the minds of this particular coast Congo people certain great categories of thought exist. For instance, he would devise a category which should contain four visible and four invisible parts, or another which should range from 0 to 9, and should correspond with certain classes of Bantu prefixes; and again others which correspond with ideas of God, the procreation of the human species, abstract qualities, such as receptivity, originality, order, manner, action, quality, &c.

To anyone who knows the negro as well as the present reviewer may claim to do, much of this appears impossibly fantastic and unreal; and when such theories are based on a misunderstanding (sometimes) of the original form and purport of prefixes in tongues closely related to the Bavili and similar correspondence of word roots, they reduce one to something like despair; for Mr. Dennett, who, as regards his recorded facts, is often so accurate and so helpful to students of Africa, wastes his time and thoughts on prolix theories which seem to be devoid of any scientific foundation. If, as he says in the beginning of his book, he has won over that notable student of the Bantu tongues, Miss Alice Werner, to a belief in, or even a toleration of, his theories given in "At the Back of the Black Man's Mind" and in the present pamphlet, it can only be deeply regretted that both of them should be following a will-o'-the-wisp. This opinion, most regretfully written, does not prevent "Notes on West African Categories" from being a work of considerable interest, and containing many new observations of value which seem to the reviewer perfectly sound as statements of fact.

THE VOICE OF LYELL.

The Student's Lyell: the Principles and Methods of Geology, as applied to the Investigation of the Past History of the Earth and its Inhabitants, with Historical Introduction. Edited by Prof. J. W. Judd, C.B., F.R.S. Second edition, revised and enlarged. Pp. 645. (London: J. Murray, 1911.) Price 7s. 6d. net.

IT is most fitting that the revision of Lyell's "Students' Elements of Geology" should be again carried out by Prof. J. W. Judd, who brings

to his work such intimate knowledge of Lyell himself, and such broad experience as a geological teacher. Prof. Judd's pupils in many lands will find again in this volume those stimulating memories of Lyell's life and work which they received from their own master in the Royal School of Mines. The "historical introduction" to the present edition, occupying fifty-six pages, is not only a welcome essay on the influence exerted by the doctrine of causes now in action, but also a defence (pp 49–52) of Lyell from the charge of excessive uniformitarianism. Those who have not made themselves acquainted, as Prof. Judd has done, with the extravagant speculations of geological divines and of laymen aspiring to divinity, before the days when the influence of Hutton, von Hoff, and Lyell came to be generally appreciated, can scarcely realise the sense of calm and order that was brought by these authors into a world of controversy. Charles Darwin's admiration for the "Principles of Geology" would alone assure us of Lyell's position as a thinker; and now, in turning the pages of this new issue of his admirable text-book, we are again reminded that here was a man who wrote because, and only because, the spirit moved him.

The refined woodcuts are here that we first knew in 1871. Drawings of such modernities as radiolarian ooze and thin sections of rocks have been introduced, and toothed birds and other American vertebrates are illustrated; but the view of geology remains, in the hands of so sympathetic an editor, essentially that of Lyell in his habit as he lived. We look back into the past from our experience of the present; a pleasant emphasis is laid upon the Tertiary strata throughout Europe; and the work reminds us in so many places of the history of geological thought that it still stands apart from any other text-book.

Supplementary notes have been added (pp. 601 to 610) directing attention to many recent discoveries, and these, in so limited a compass, naturally provide food for thought rather than a complete exposition. We miss a reference to the older glacial epochs; the stratigraphical breaks indicated in the diagram on p. 441 surely exaggerate enormously the imperfection of the European record; and many geologists would like to expand the modest view of contact-metamorphism stated on p. 553. It is easy to comment on details where so wide a range of subjects has been dealt with. The essential feature is that the editor has handed on to us undimmed the lantern lit by Lyell.

G. A. J. C.

MODERN KNOWLEDGE HANDBOOKS.

(1) *Polar Exploration.* By Dr. W. S. Bruce. Pp. 256.
(2) *The Evolution of Plants.* By Dr. D. H. Scott, F.R.S. Pp. 256.
(3) *Modern Geography.* By Dr. M. I. Newbigin. Pp. 256.
(Home University Library of Modern Knowledge.) (London: Williams and Norgate, n.d.) Price 1s. net each.

THE three volumes the titles of which are given above belong to the Home University Library of Modern Knowledge, published by Messrs. Williams and Norgate under the editorship of Prof. Murray, Mr. Herbert Fisher, and Prof. J. Arthur Thomson. Each is intended to be a concise handbook to the subject with which it deals, and by an acknowledged authority. The object of the series is to place within everyone's reach, at the lowest possible price, authoritative information on any branch of history, science, art, literature, philosophy, or religion with which he desires to become acquainted. Ten volumes will be issued each year. The first on our list, "Polar Exploration," by Dr. Bruce, is what the author has termed a "traveller's sample" of the Arctic and Antarctic warehouses. No one is more competent to present their contents than one who has personally sampled as he has done, more than once, both polar regions, and has besides learned much in regard to them from personal conversations and correspondence during the past twenty years with living polar explorers, including the veteran Sir Joseph Hooker, to whom the volume is dedicated. The personal note predominates, as it needs must, and those parts visited by the author are dealt with in greater detail than those which he has not had an opportunity of visiting. The aspects of the subject dealt with in the present volume are the astronomical features of the polar regions; the ice, both land and sea, its coloration and that of snow; the vegetation, the animal life and the physics of these regions; their meteorology, magnetism, aurora, and tides, with a final chapter on the aims and objects of modern polar exploration. Not the least important addition to the physics of the southern seas made by the Scottish national Antarctic expedition was the discovery of the existence of a long "rise" extending in a curve from Madagascar *via* Bouvet Island, the Sandwich group, the South Orkneys, Graham Land, and the Falklands to South America. "Thus Antarctica, South America, and Madagascar and probably South Africa become connected with one another in a most direct manner by this rise." The volume smacks of a Stevensonian voyage.

(2) "The Evolution of Plants" is a masterly *résumé* of this extremely difficult subject by one of our highest authorities, himself a leading investigator in palæobotany. Dr. Scott's object in this book is to try to trace historically the course which the evolution of plants has actually followed, confining himself to those groups for which the evidence is most satisfactory. The questions here considered are: the evolution of true-flowering plants; that of the seed-plants generally; and, thirdly, that of the great groups of the higher cryptogams, or spore-plants, the ferns, the club mosses, the horsetails and sphenophylls. Dr. Scott's work "needs no bush."

(3) Dr. Marion Newbigin dates the commencement of "modern geography" only from 1859, the year when the celebrated geographers Humboldt and Ritter died and Darwin's "Origin" appeared. The doctrine of evolution has had an enormous effect on geographical science, and its development has been so great that to give a complete survey of the subject would be impossible. Her volume, "Modern Geography," therefore, suggests only some of the

lines along which research is proceeding most actively at the present time, special stress being laid upon those aspects of the subject which are not as yet fully treated in the smaller text-books.

The first four chapters deal with a general survey of the earth's surface, its mountains and ocean depths, the formation of its hills and valleys due to atmospheric agents, running water and ice, and the effects of climate on the distribution of other phenomena on the surface of the globe. In the successive chapters the author describes the three chief zones of vegetation, the Mediterranean scrub land, the temperate forest zone, and the steppe or pasture land, and that as each of these is determined by climate, each again has special types of cultivated plants and domesticated animals.

"It is interesting to note," adds the author, "what cannot be a pure coincidence [and yet may it not be so?], that in Europe three races of men exist, which show a certain rough correspondence to the three zones of vegetation. The Mediterranean type of vegetation and climate is associated" with the Mediterranean race. . . . "The characteristic inhabitants of the temperate forest region of Europe are members of the race called Teutonic or Nordic . . . the steppe and pasture lands . . . tend to be occupied by a third race . . . to which the . . . name of Alpine has been given."

The penultimate chapter is devoted to the races of Europe and their origin, and the last to the distribution of minerals and the localisation of industries and of towns. "Modern Geography" is a suggestive book.

Although the space at our disposal precludes a detailed notice of these volumes, we can warmly and conscientiously recommend them to those interested in the subjects with which they deal. All three are provided with full indexes, and "The Evolution of Plants" has besides an excellent bibliography of the most important works on palæobotany.

OUR BOOK SHELF.

Medical Science of To-day: a Popular Account of the More Recent Developments in Medicine and Surgery. By Dr. Willmott Evans. Pp. 324. (London: Seeley, Service, and Co., Ltd., 1912.) Price 5*s.* net.

THIS is a very delightful book. None of the natural sciences has greater wonders to tell than medical science; none touches more nearly our admiration of good work slowly brought to success. Dr. Willmott Evans is an excellent interpreter; he understands the art of freeing the wonder of the discovery itself from the wrappings of long words put round it by the doctors; he makes the reader feel the intense human significance of the many facts on which the present fabric of medicine and surgery is founded and built; and his book ought to be very widely read and remembered.

Of course, with such an "imperial theme," it was not possible for him to say all that ought to be said. The embarrassment of riches left him only a paragraph or two for methods each deserving a chapter. But he ought to have found room to say more about the tremendous influence of the experimental method in medical science. For instance, his mention of brain-surgery does not do justice to the experimental study of cerebral localisation; and the same fault occurs in his chapter on organo-therapy. And, of course, there are omissions of less importance; thus he speaks of yellow fever without naming Walte Reed, and he describes myxœdema without givin photographs of cases before and after thyroid treat ment. He might with advantage have left out th chapters or subchapters on patent medicines, idiosyn crasies, and malingering; the chapters on legal medi cine also want thinning.

The one grave defect in the book is the over shadowing of methods by results; he shows us th thing made, not the thing in the making. Still, h has written a book which is excellent reading; h plainly has enjoyed writing it, and it gives a faithfu and valuable account of the modern science and ar of medicine, surgery, and preventive medicine.

Climatic Control. By L. C. W. Bonacina. Pp. viii + 167. (London: A. and C. Black, 1911.) Price 2*s.*

WORKS on climatology and articles in meteorologica text-books treating of that subject abound in variou forms, but that there is still room for others dealin with different aspects of this important question i shown by the interesting and useful little volume nov under review. It is published as one of the series o "Black's School Geography," and, being intende primarily for British students, prominence is give to the climate of this country, but that of other "well known lands," selected as representative of the variou zones and regions, is considered at some length.

In an instructive chapter on the general principle of climatology, the factors which produce variation in different parts of the world—*e.g.* latitude, altitude prevailing winds, &c.—are separately discussed, an this is followed by chapters (1) on the types of lan and the effect of the prime elements of light, heat an moisture, the distribution of vegetation being take as a rough criterion of the climatic variations; and (the influence of climate upon man. The whole c these various aspects are treated in a manner tha cannot fail to attract the attention of students, an to induce them to pursue the subject further. Th last chapter deals with meteorology and is in tended for more advanced students. This chapte like those preceding it, exhibits an intimat knowledge of the subject, and we regret that i was found necessary, for lack of space, to omit ques tions relating to atmospheric electricity—*e.g.* thunde storms, &c.—and to optical phenomena.

The effect of the rotation of the earth on the ci culation of the air and on the behaviour of cyclone and anticyclones and many other questions sometime presenting difficulty to students are clearly explaine A few well-chosen synoptic charts, recently publishe by the Meteorological Office, are added to explai some of the principal types of weather.

An Introduction to Chemical Theory. By Dr. A Scott, F.R.S. Second edition. Pp. viii + 27 (London: A. and C. Black, 1911.) Price 5*s.* net.

THE first edition of this book was published twent years ago, just as the "new" physical chemistry wa flowing into this country and gaining admission t lecture courses and text-books. It was in a way th last of its race, and it still retains in the new editio a marked mid-Victorian flavour. This is not said i disparagement; indeed, the restraint shown by th author on the more speculative side of theoretica chemistry is a reminder of what in some respects wer better days.

The distinction between chemical philosophy general chemistry, and physical chemistry has becom very vague, but Dr. Scott's book may be describe as dealing rather with chemical philosophy tha physical chemistry, and in that character it has som distinctive features which may give it a place in th

student's armoury. Such, for example, are the two chapters on the classification of compounds.

The treatment throughout is simple and lucid, and there is nothing that is likely to puzzle or mystify a reader. The contents will give him a good, useful store of information relating to the theoretical side of chemistry, though it will be meagre on the topics which have come to the front during the last twenty years, and to which, in a mere revision, it has scarcely been possible to do justice. In some cases the faults pass beyond those of omission, as in the confusion between dissociation and hydrolysis on p. 172, the account of "palladium hydride" on p. 171 and the definition of cryohydrates on p. 255. A. S.

Marvels of the Universe. A Popular Work on the Marvels of the Heavens, the Earth, Plant Life, Animal Life, the Mighty Deep. By various authors. In about twenty-four fortnightly parts. Part i., pp. 48. Part ii., pp. 48. (London: Hutchinson and Co., n.d.) Price 7d. net each part.

OF the attractiveness of this serial publication it would be difficult to write too highly. Each part contains four full-page illustrations in colour, remarkable alike for their beauty and accuracy, and a profusion of excellent pictures in black and white, most of which are from photographs.

The contributors are well-qualified authorities on the subjects they have undertaken, and what they have written is appropriate to the work. The selection of topics has been guided entirely by what is likely to arrest the attention of the non-scientific general reader, with the result that instead of an orderly introduction to science, we have a series of short, bright views of some of the wonders of nature, arranged in no logical sequence, but partaking of the character of a scientific scrap-book, using the term to express disjunctiveness rather than depreciation.

Unrelated as the articles are, they may serve a very useful purpose and succeed in attracting readers to the more serious study of some science in which they will be led themselves to observe and record what is happening in the world around them, as well as to take an interest in the explorations of others.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Scientific Misappropriation of Scientific Terms.

WHILE fully sympathising with Prof. Gregory in his condemnation of the scientific misappropriation of popular terms, and, indeed, objecting to the scientific *appropriation* of such terms where it would be better to employ a universally intelligible technical language, still, it seems to me that even more deserving of condemnation is the misappropriation by one group of scientific workers of the scientific terms used by another group. This procedure is the more objectionable when the two groups of workers are in adjoining fields. It does not greatly hurt anyone that an astronomer should mean by an "asteroid" something quite different from that which a zoologist means; but it does matter when one biologist uses a term in a different sense from another biologist.

Of late years some of us have felt driven to protest against Prof. H. de Vries's use of the term "mutation" in a sense differing in an apparently trivial, yet philosophically important, way from the use of the term by its original inventor—the palæontologist Waagen. Now we find the followers of Prof. de Vries, notably Prof. Johanssen, robbing the systematic biologists of their term "genotype." First proposed by Prof. C. Schuchert in 1897, this term has come into very general use to denote the type-species of a genus. There has been in the past so much confusion between the different senses of the word "type," and this confusion has given rise to so much regrettable confusion of thought, that this latest malappropriation should only need pointing out to be at once stopped. Unfortunately, this simple action has not had the desired effect, and therefore I am impelled to make a protest in your widely read pages. F. A. BATHER.

Wimbledon, November 2.

The Electro-vegetometer.

EXPERIMENTS with electricity as a stimulant to plant growth were made with alleged success 165 years ago, when Mr. Maimbray, of Edinburgh, electrified two myrtles throughout October, 1746, for several hours a day, with the consequence that next summer they blossomed sooner than their neighbours (Priestley's "History of Electricity," part viii., sec. 4).

Shortly after this the Abbé Nollet made similar experiments with electrified seeds in pots, and claimed equally successful results. M. Achard, of Berlin, and other independent observers confirmed the experiments; and the beneficial effect of electrification on plant life was almost an accepted discovery when a Dr. Ingenhousz, after exhaustive experiments, completely refuted all the conclusions hitherto arrived at, and proved that the only effect of electrification was to hinder plant life!

Dr. Carmoy and the Abbé Ormoy later resumed the investigation, and testified to favourable results.

Next the Abbé Berthelon reconciled these divergent conclusions by announcing that electricity in a moderate application was beneficial, but could be applied in excess with harmful results; and he advocated as the safest method the utilisation of atmospheric electricity, which he said rarely rose to a strength injurious to the most delicate plant. He published a suggestion, recently credited by Sir William Ramsay as a new and ingenious theory of Sir Oliver Lodge's, that the pointed leaves of plants acted as conductors of atmospheric electricity, and were an important factor in the prolific vegetation of forests.

The Abbé Berthelon, who utilised both natural and artificial electrification, devised what he called the "electro-vegetometer," which consisted of an insulated series of sharp iron points projecting vertically upwards at a mast-head and connected by chains with similar iron points pointing downwards just over the plants to be experimented on. He states that "the happiest effects were perceived, viz. different plants, herbs, and fruits in greater forwardness than usual, more multiplied, and of better quality."

Until lately all these alleged successes were supposed to have been imaginary; and the question is, Will the recent experiments prove that there was more in the earlier ones than has been supposed, or will the present trials turn out to be, with their predecessors, further examples of myths of science, like the Blondlot rays and Mrs. Somerville's supposed discovery of a magnetising power in solar light? CHARLES E. BENHAM.

Colchester, November 5.

November Meteor-showers.

THE early part of November does not present anything very noteworthy as regards meteoric phenomena, which may be said to begin about November 9, the following being the principal meteor-showers of the month:—

Epoch November 9, 6h. (G.M.T.), first order of magnitude. Principal maximum, November 11, 0h. 30m.; secondary maxima, November 9, 11h. 50m., and November 10, 10h. 40m.

Epoch November 10, 15h. 30m., twenty-second order of magnitude. Principal maximum, November 11, 11h. 30m.; secondary maxima, November 11, 19h. 20m., and November 12, 7h. 40m.

Epoch November 13, 16h., thirtieth order of magnitude. Principal maximum, November 14, 22h. 50m.; secondary maxima, November 15, 9h. 30m., and November 16, 13h. 15m. and 17h. 30m.

Epoch November 16, 10h., thirteenth order of magnitude. Principal maximum, November 15, 21h. 10m.; secondary maximum, November 15, 7h. 15m.

Epoch November 17, 3h. 30m., tenth order of magnitude. Principal maximum, November 17, 17h. 25m.; secondary maxima, November 17, 23h. 30m., and November 18, 5h. 5m.

Epoch November 17, 15h. 30m., approximately sixth order of magnitude. Principal maximum, November 19, 12h. 55m.; secondary maxima, November 18, 15h. 15m., and November 19, 22h. 10m.

Epoch November 24, 2h. 30m., approximately fourth order of magnitude. Principal maximum, November 23, 5h. 30m.; secondary maxima, November 22, 15h. 20m. and 18h. 20m.

Epoch November 25, 4h. 40m., eighteenth order of magnitude. Principal maximum, November 24, 2h. 35m.; secondary maxima, November 24, 12h. 40m. and 23h. 10m.

It is significant that, of the eight principal epochs of the month, no fewer than six fall due during the period of November 9–20. This, therefore, is the part of the month richest in meteoric events. The two remaining epochs of November 24–25, though nominally strong, do not rank in importance with the foregoing six.

Of these six there are three that call for special mention. The first, commencing on November 9, has the highest meteoric intensity of the month; but the epoch of November 17, 3h. 30m., may prove to be the most interesting, as it bears a certain resemblance to the epoch of November 15, 1905, and in the writer's opinion is liable to be associated with auroral phenomena. The small intermediate epoch of November 13, 16h., is the only one that places maxima between 12h. and 18h. on any of the three nights November 14–16, two of its secondary maxima becoming due between these hours on the night of November 16. The general Leonid maximum will therefore probably be best observed on the night of November 16, but late members of this well-known star shower are likely to be strongly in evidence also on the following night.

JOHN R. HENRY.

2 Belgrave Villas, Rathmines, Dublin, November 6.

Tick (Ixodoidea) Generic Names to be included in the "Official List of Zoological Names."

(1) THE international committee invited by the secretary of the International Commission on Zoological Nomenclature to make a detailed study of the nomenclature of ticks (Ixodoidea), and consisting of the following specialists in this group, W. Dönitz (Berlin), Albert Hassall (Washington), L. G. Neumann (Toulouse), G. H. F. Nuttall (Cambridge), and Cecil Warburton (London), has submitted its first report.

(2) Said committee unanimously agrees that the following eight generic names are the correct names for the genera in question, and that the correct genotypes, according to the international rules of zoological nomenclature, are the species cited:—

Amblyomma Koch, 1844a, 223–231, type *cajennense* Fabricius, 1787.

Argas Latreille, 1796a, 178, type *reflexus* Fabricius, 1794.

Dermacentor Koch, 1844a, 235–237, type *reticulatus* Fabricius, 1794.

Haemaphysalis Koch, 1844a, 237, type *concinna* Koch.

Hyalomma Koch, 1844a, 220–223, type *aegyptium* Linnæus.

Ixodes Latreille, 1796a, 179, type *ricinus* Linnæus.

Rhipicentor Nuttall and Warburton, 1908, 398, type *bicornis* Nuttall and Warburton.

Rhipicephalus Koch, 1844a, 238, 239, type *sanguineus* Latreille.

(3) Notice is hereby given that the undersigned will wait until May 1, 1912, for any zoologist to raise any objection to any part of the report of the special committee. If no valid point is raised by the date mentioned, the undersigned will transmit the list to the International Commission with the motion that these names be incorporated in the "Official List of Zoological Names" provided for by the last International Zoological Congress.

All correspondence on this subject should be directed to

C. W. STILES.

(Secretary International Commission on Zoological Nomenclature.)

Hygienic Laboratory, Washington, D.C., October 30.

Localising Minute Leaks in Vacuum Apparatus.

IN view of the fact that in many branches of physical research there has arisen of late years the necessity for complicated apparatus to be kept at a high state of exhaustion, it may interest your readers to hear of a simple method of localising minute leaks.

In the case of leaks in "all glass" apparatus, I have for many years used with success Goldstein's spark method. This consists in disconnecting the kathode lead from the apparatus, putting in a small alternate spark-gap, and exploring over the suspected joints with the loose lead until a brilliant discharge to the inside of the apparatus indicates the position of the leak. The objections to this method are that if parts of the glass are very thin a hole may be made where none previously existed; it obviously cannot be used near a terminal, or at all with a "wax" joint.

An apparatus of mine involving seven distinct and complex sealing-wax joints recently developed a microscopic leak of about 1/100 mm. per hour. Being faced with the alternative of pulling the whole apparatus down and remaking every joint, it occurred to me that the extremely sensitive nature of the discharge in air to change its colour when in the presence of carbon compounds (it is, in fact, by the change from the grey of CO to the crimson of N that leaks are generally first seen) might be used with advantage. I therefore wiped each joint over with a small pad of cotton-wool soaked in petrol, keeping the discharge going meanwhile, and the instant the real offender was reached—a "metal-wax-glass" joint in this case—the discharge turned abruptly from red to blue. The method seems extraordinarily delicate, and should be applicable to all cases of air leak so long as the latter is not so large as to prevent the discharge passing.

F. W. ASTON.

Cavendish Laboratory, Cambridge, October 31.

Multiple Rainbows.

ON Tuesday morning last, October 31, a succession of rainbows of extraordinary brilliance was visible here. The most brilliant appeared at 8.45 a.m., and lasted about five minutes.

The sun was shining brilliantly, and the atmosphere to the east was remarkably clear, while the rain-storms came up from the Bristol Channel, eight miles to the west. At 8.45 a.m. six rainbows were visible, *three* inside the main bow and very close to it, the colours being in the same order as those on the main bow, and two outside, the colours of the first being in reversed order, while the second was faint, and nearly white. Four of the rainbows were quite perfect, but the innermost of the three internal bows was partly broken, only three-quarters being visible. About one-third of the extreme outer bow was visible.

E. NEWBERY.

Sidcot School, Winscombe, Somerset, November 6.

Dangerous Mixtures.

I SHOULD like to direct attention to the dangerous nature of a mixture consisting of magnesium powder and silver nitrate.

When a small quantity (2 to 3 grams) of magnesium powder is mixed with an equal bulk of powdered silver nitrate in a metal dish, and then from the end of a long glass rod a drop of water is allowed to fall on the mixture, a slight explosion occurs, accompanied by a vivid flash.

The unexpected violence of this reaction led to serious burns in my own case.

Mercuric nitrate when substituted for silver nitrate also reacts vigorously with magnesium powder under the same conditions, brown fumes, but no flash, being produced. With barium nitrate the action is slight, heating only appearing to take place.

HAROLD CALAM.

The University, Leeds, October 27.

THE SOLAR PHYSICS OBSERVATORY.

In last week's NATURE we gave the terms of reference of the departmental committee appointed to consider alternative schemes for transferring this observatory to Fosterdown (Caterham) or to Cambridge.

We are informed that the Treasury has forwarded the report of the committee on this subject to Cambridge, and that it is being considered there; so far we believe no communication has been made to the Solar Physics Committee, the body appointed more than twenty years ago to advise the Government in such matters.

We may summarise now the action taken by the committee and the Board of Education as already recorded in NATURE during the last five years.

(1) In 1906 the Board informed the committee that the land on which the Observatory is situate was required for the Science Museum, and requested them to make inquiries regarding a new site.

(2) The committee formulated the conditions to be fulfilled, and, after inspection of all available Government land in 1907, fixed upon Fosterdown as fully satisfying all the conditions.

(3) The Treasury, in full knowledge of this, proposed Cambridge as an alternative site, although it fulfilled none of the required conditions.

(4) The committee pointed out that this raised questions concerning administration, &c., and asked for more information, and suggested a committee to obtain it, consisting of representatives of the Treasury, the Board of Education, the Solar Physics Observatory, and the Meteorological Office, to consider fully the question of the alternative sites in all its bearing.

(5) Without any communication with the committee, the Treasury requested the War Office to sell the Fosterdown site.

(6) As a result of a memorial to the Prime Minister this proceeding was at once stopped.

(7) The Treasury, thus compelled to hold an inquiry, instead of such a body as that suggested by the committee, with knowledge of the work done in the Solar Physics Observatory and the questions of administration involved, appointed a committee consisting of three fellows of a Cambridge college and the holder of an honorary degree of the University.

(8) The majority of this committee has selected Cambridge as the future site for the observatory.

THE SITES CONTRASTED.

Up to the present time the actual conditions of the two sites as observing stations have not been published, so some trouble has been taken to prepare maps to indicate their relative efficiency.

To illustrate this the accompanying two charts are here reproduced, the first (Fig. 1) representing the Cambridge site and its neighbourhood, and the second (Fig. 2) that at Fosterdown. A study of these two charts will at once demonstrate the respective values of the positions for an observatory to be erected *for all time.*

It is well recognised that the best observations of the sun are made soon after the sun has risen, so that it is essential that the eastern horizon as seen from the observatory should be open and free from a smoky atmosphere. In the plans, lines showing the directions of the sun at sunrise at both the summer and winter solstices have been indicated in order to point out the kind of country (town or fields) over which these observations in the east should be made.

The following comparisons show how the conditions laid down by the Solar Physics Committee are fulfilled or the reverse by the two sites in question:—

"The observatory should be at an elevation of not less than 250 feet, if practicable."

FIG. 1.—Cambridge. The selected site, 70 feet above sea-level, is at the centre of the half-mile and mile circles, and lies 45 feet above the river flats to the eastward. The lines SS and WS represent the directions of sunrise at the summer and winter solstices respectively. Solar observations, which have to be made soon after sunrise, must therefore be made through smoky and misty atmosphere due to the town and river valley respectively.

Cambridge.—75 feet.

Fosterdown.—800 feet.

"In any case it should not be in a smoke area."

Cambridge.—Near a smoke area, namely, the town of Cambridge, and this lies to the east and south-east of the site, and is extending westwards, *i.e.* in the direction of the observatory.

Fosterdown.—No smoke area.

"It should be away from river valley mists and not upon a clay soil (chalk or gravel would be quite satisfactory)."

Cambridge.—River mists and flooded areas by the River Cam—to the east and south-east of the site.

Fosterdown.—No river near the site.

"In the configuration of the ground the important considerations are that the site should not be exposed

to violent winds, and that it should afford as clear horizon as possible, especially to east, south, and west."

Cambridge.—The extension of Cambridge in the direction of the site is increasing, and there is no *natural* guarantee to prevent buildings (which mean smoke) from being erected on any of the sides of the observatory site.

Fosterdown.—The configuration of the site is such that the horizons will be open and clear *for all time*.

It may be further stated that while at Cambridge a main road passes close to the site of the observatory and traffic along it even now shakes the ground, at Fosterdown no such road can be constructed, and therefore no such earth tremors need be feared.

It will therefore be seen that for the work's sake it would be much better to place the observatory in the best position at once, even if it may cost a few hundred pounds more, than to locate it at Cambridge,

At the same time that this report was presented to both Houses of Parliament the third report of the committee appointed to advise the Government on this matter, called the Solar Physics Committee, was also presented. This covers the period 1889–1909 (two previous reports presented in 1882 and 1889 dealt with the period from 1879, when the observatory was founded by the Government).

A perusal of this report enables us to see what work has been done in the past. The report of the departmental committee deals with proposals for its future.

The situation is as follows:—

A Government observatory, more than thirty years old, has to be moved from its present position because the land is wanted for the buildings of the new Science Museum.

When the question of the change of site of the observatory was first brought up a thorough investigation was made by the Solar Physics Committee. They formulated the conditions which had to be secured, and proceeded to search for a suitable site. The conditions which they laid down are given in the departmental committee's report (p. 4)—roughly, the site should be as high as possible, to

FIG. 2.—Fosterdown. The selected site, 800 feet above sea-level, is at the centre of the half-mile and mile circles, and lies 100 feet above all the neighbouring country with the exception of the small 800-foot area to the north of east, which is on the same level as the site. The lines SS and WS are the directions of sunrise at the summer and winter solstices. The figure shows the open and clear nature of the horizon in all directions.

where at the present time the observing conditions are not good; where year by year they will be getting worse; and where in a short period they will become intolerable for similar reasons which make the present site at Kensington undesirable. The cost of such a removal from Cambridge would entail an additional and unnecessary expense.

"THE TIMES" ON THE SITUATION.

We gave last week two articles from the daily Press—*The Morning Post* and *The Daily Graphic*—giving views as to the committee's report. We now add a letter which appeared in Tuesday's *Times* from an occasional correspondent:—

In your issue of October 27 you published the recommendations of the departmental committee on the Solar Physics Observatory.

secure the least thickness and disturbance of air, and a clear horizon, especially to the east, south, and west; no town smoke or glare at night; proximity to London to facilitate communication with libraries, societies, and men of science.

In choosing a site for a future observatory it was natural that the position should be so selected that in years to come the observing conditions would not be hampered or rendered less efficient by changes in the close surrounding area. When the Solar Physics Committee selected the Fosterdown site they evidently kept this condition well in mind, for an examination of it shows that it is practically impossible for any buildings or roads to be constructed in any direction which will take away from the present efficient observing conditions. Thus the site will probably be as good in 100 years' time as it is now.

Some time ago the Solar Physics Committee was informed that Cambridge had been proposed as an alternative site; the committee hesitated to accept this, pointed out

the necessity for further inquiry, and suggested an inter-departmental committee on which the Treasury, the Board of Education, the Solar Physics Observatory, and the Meteorological Office should be represented.

The committee actually appointed consisted of three persons who are or have been fellows of Trinity College, with the addition of a distinguished honorary graduate of the University of Cambridge. In the terms of reference a condition is assumed that the sum spent in the future upkeep at either place should be approximately the same as that now expended in the present observatory.

Out of the three scientific members of this committee, two, the Astronomer Royal and Dr. Schuster, agreed that the Cambridge site should be preferred, while one, Dr. Glazebrook, the director of the National Physical Laboratory, dissented.

In making a very careful examination of the report of the departmental committee, together with the evidence and appendices, it is really a matter of great difficulty to understand, in the face of the evidence offered, how Messrs. Dyson and Schuster arrived at their conclusion.

The question of site may first be dealt with. The superiority of the Fosterdown site is frankly acknowledged, and evidence is given that some of the present disadvantageous conditions at Cambridge may be much worse in the future. There is no guarantee that the land surrounding the proposed Cambridge site will not be built on, that tram-cars and other heavy traffic will not run along the main road which bounds it. In short, there is no guarantee that this part of the outskirts of Cambridge will not in the near future be an important suburb of Cambridge.

One of the greatest objections to Cambridge is touched on in cavalier fashion. Cambridge, like London, is lighted by electricity; and one of the points in favour of Fosterdown was that town glare at night would be abolished, and that long-exposure photography on the spectra of stars and nebulæ, which is carried on under bad conditions at present at South Kensington, would be rendered more fruitful of results.

As we learn from the solar physics report, this work requires at present the attendance of three assistants on every fine night.

Q. 169.—Is there any interference owing to the town light at the observatory in Cambridge?

Answer.—I do not think anything that would affect solar observations—

is all we can find on this point; and it does not suggest that we are likely to have a continuance of the study of the detailed chemistry of stellar spectra which for many years past has formed part of the routine work of the Solar Physics Observatory, and is not done elsewhere. Town glare naturally does not affect solar observations, because the sun can be observed only by day, while the town is lit only by night. But it does very seriously affect the astrophysical work of the Solar Physics Observatory, which can be carried on only at night. If it is really intended to put an end to a unique investigation of stellar chemistry and physics, the question ought surely to be debated on its merits, and not simply hustled out of sight. There is reason to fear that this is the intention, not only because of the non-recognition of anything beyond solar observation, but also because it is to be gathered from the representative who gave evidence for Cambridge that in the Cambridge view it is not simply a question of transferring the observatory, but of dismissing its staff and putting an end to it as it exists.

Of the ten members of the staff, from Sir Norman Lockyer downwards, not more than two are to be employed (Q. 222), and even none of the existing staff may be of the right "calibre" (Q. 139).

The departmental committee apparently does not accept this (Report, Section 15).

It is understood that the Government desires to relieve itself of the direct control of the Solar Physics Observatory, but that at the same time it acknowledges the value of the work done by that observatory by its willingness to continue the grant at present made for its maintenance. The inducement offered by Cambridge University to transfer control to its hands is that the University undertakes to provide a suitable building for the work, which involves no very serious expenditure. If public money to the amount of 3000*l.* a year is to be handed over to the University on account of certain specified work, then security should be taken that the public shall get value for its money, and that the specified work shall be efficiently carried on. Otherwise the transaction will merely amount to giving the University 3000*l.* a year to spend as it pleases in return for the erection of a building worth 200*l.* or 250*l.* a year.

Now in order that the work shall be carried on efficiently—that is to say, the astrophysical work, which, in spite of its title, is the speciality of the Solar Physics Observatory—it is not enough that a suitable building should be erected, even though it be manned by persons of the "right calibre." It is also necessary that the suitable building should be upon a suitable site, and the only suitable site for an observatory obviously is a site permitting its work of observation and record to be performed in the best conditions attainable. It will not be seriously argued by any responsible person that Cambridge offers the best attainable site for carrying on the astrophysical work of the Solar Physics Observatory. That work involves long exposures of sensitive plates to the light of particular stars. It is necessary that the star should be followed with the utmost accuracy in its diurnal motion, and it is obvious that vibration of the instruments due to heavy traffic in the vicinity cannot conduce to sharpness of definition. If the star has to be photographed through the illuminated haze that hangs over every well-lighted town, another serious difficulty is thrown in the way of the observer, and when spectrographic complications are added the difficulties become indefinitely more formidable.

Thus, while it may be right that the Government should rid itself of direct control of the Solar Physics Observatory, and while it may be right that Cambridge University should assume control, it cannot be right that the University should erect the observatory in Cambridge. For Cambridge is shown by the departmental committee itself to be a bad observing station for this particular work, and to be very likely to become progressively worse. A site can easily be found free from the objections that attach to Cambridge; and if astrophysical work is to be carried on at all with public money, the public have a right to demand that such a site shall be chosen. In placing the observatory at a distance from the University, Cambridge would only be following the practice of other universities, such as those of California and Chicago, which prosecute analogous researches upon the principle that observatories must be placed where the things to be observed can be best observed.

THE ENCYCLOPÆDIA OF SPORT.[1]

AS the third volume commences with hunting and concludes with racing, while it also comprises articles on lawn tennis and polo, it will be obvious that a large portion of its contents does not come within the purview of a journal like NATURE. Nevertheless, there are numerous articles connected with natural history which call for brief mention. As a whole, these articles have been brought well up to date, although in some instances there is a certain amount of repetition, and occasionally discrepancies, when two writers treat of the same subject from different points of view. The illustrations are numerous, and for the most part good (as will be evident from the one here reproduced), but the accompanying legends are in some instances not so full as is desirable. On page 85, for instance, a doe and kid are simply lettered Himalayan Ibex, while there is no indication to show whether the "Caucasian Ibex," figured on the next page, is an example of the western or eastern tur. Misprints seem to be few, although the specific name of the mule-deer is given as *nemionus* in place of *hemionus,* while its alternative

[1] "The Encyclopædia of Sport and Games" Edited by the Earl of Suffolk and Berkshire. Vol. iii., Hunting—Racing. Pp. viii + 448. Vol. iv., Rackets to Zebra. Pp viii+471. (London: W. Heinemann, 1911.) Price 10*s.* 6*d.* net; abroad 12*s.* 6*d.* net.

generic name, Cariacus, is printed with a small initial letter.

The most valuable of the natural history articles, in our opinion, is the one by Mr. Rothschild on pheasants, in which the number of species of the typical genus Phasianus is reduced from about thirty-five to half a dozen, all the forms allied to *colchicus* being regarded as local races or colour-phases of that species. As these will all interbreed and propagate fertile offspring, the new classification is far preferable to the old. In this connection it may be noted that the author of the article on partridges refers to the red-legged *Caccabis rufa* as a "variety," instead of a species. It is high time that all sportsmen who attempt to write on natural history subjects should make themselves acquainted with the respective significations of the terms species, race, and variety. Before leaving birds, reference may be made to a statement that the smooth surface of the shells of the eggs of North African ostriches is probably brought about by grinding and polishing on the part of the Arabs from whom they are generally procured. It has, however, been pointed out in *The Field* that eggs of North African ostriches laid at Woburn and Tring prove the smooth surface to be natural.

Many of the articles on big game are by Mr. H. A. Bryden, who always writes in a picturesque, if not strictly accurate, style. His worst blunder occurs under the heading Okapi, where it is stated that this animal "may be looked upon as a connecting-link between the giraffe and the antelope, having marked characteristics common to both races." If the okapi is nearly related to any family (not "race") of ruminants other than the giraffe group, it is to the deer, and not the antelopes, the alleged resemblance in bodily form to certain members of the latter group being a feature utterly devoid of systematic value.

Mr. Roosevelt communicates articles in both the third and fourth volumes on American game animals, such as peccari, prairie-chicken, pronghorn, puma, and turkey, all of which are admirable from the sportsman's point of view, although they do not enter deeply into the natural history of the subject.

From Mr R. B. Marston's excellent article on pike and pike-fishing in vol. iii. we reproduce a striking illustration of a pike feeding, other photographs in the fourth volume showing the mode in which salmon take their prey.

Among the zoological articles in vol. iv., it may be noted that the one on red deer appears in much the same form as in the original edition, the Manchurian *Cervus xanthopygus* being still affiliated to the European species instead of to the wapiti, while the Sikhim *C. affinis* is erroneously stated to come close to the latter. The rhinoceros articles, on the other hand, have been well revised, and do full justice to the discovery of the white species in the heart of equatorial Africa. In the article on the rook, Mr. Harting expresses himself as being fully convinced of the value of these birds to the farmer; and the same authority is responsible for the articles on snipe and woodcock, which appear well up to date. Sir Henry Pottinger's article on rype, or ryper (ptarmigan), illustrated (like several of the other bird-articles in this volume) by one of Mr. Thorburn's exquisite paintings, is just what might be expected from such an experienced sportsman, and the same may be said with regard to Sir Herbert Maxwell's account of the salmon. Finally, it may be mentioned that although the author of the article on trout conceals his identity under the pseudonym of "John Bickerdyke," it is satisfactory to find that his view as to the specific unity of all forms of trout is in accord with that adopted by Mr. C. T. Regan in his new book on British fishes.

Without expressing any definite opinion as to the

Photo] Pike Feeding. From "The Encyclopædia of Sport." [*J. Turner-Turner.*

purely sporting articles, we may confidently state that, in spite of a certain number of errors and shortcomings, like those mentioned above, the "Encyclopædia of Sport" supplies in the main exactly the kind of information on natural history subjects the sportsman is likely to require. R. L.

THE PROPAGATION OF EARTHQUAKE WAVES.[1]

"DOS PALABRAS," or "two little words," has a much more friendly sound than the abrupt word "preface." "Preface," standing by itself, is suggestive of a snappy military command, something like "halt" or "quick march," whilst "Dos Palabras" is the kindly invitation of a writer to the public, asking them to read his work. In the "Dos Palabras" we are told that the ordinary person only thinks about earthquake prediction and that which is utilitarian, whilst the principal object of the seismologist is to extend human knowledge about the interior of our planet.

This memoir, which was presented to the American International Congress of Science held in Buenos Ayres in 1910, although dealing especially with the propagation of earthquake waves, gives in an introduction of forty-two pages a rapid review of many problems with which modern seismology deals. From the velocity with which earthquake waves are propagated through our world, we have already learned something new about the constitution of its interior. The conclusions arrived at by these velocities as bearing upon the rigidity of our world, together with investigations made by Lord Kelvin and others on the same subject, are briefly mentioned. References are made to the investigations of Prof. Ricco which indicate a relationship between the value of gravity and the seismic and volcanic phenomena of a district. But the more general relationship between the abnormal movements of magnetic needles, earthquake disturbances, and the value of *g* in localities characterised by the presence of volcanic rocks, has been overlooked.

Sunspots, unusual movements in bodies of water, the times at which geysers erupt, barisal guns, microphonic disturbances, abnormal earth currents and other phenomena, are pointed to as subjects which should arrest the attention.

Unexpected side issues in the daily work of a seismologist—as, for example, the effect of tidal load, the transpiration of vegetation, which is always wrinkling the face of our globe, the emotional effects produced by earthquakes upon man, their effects on the behaviour of certain animals, and the exploitation of many other byways—have been overlooked. These, however, have nothing to do with Dr. Negri's chief subject, which occupies the next seventy-three pages of his publication. This entirely deals with the velocity with which earthquake motion is propagated. He starts out with the assumption that in a teleseismic record we frequently see many phases, P_1, P_2, &c., and that there are as many corresponding velocities which are distinguished as V_1, V_2, &c. He derived this idea from the publications of Dr. Ōmori. With this assumption V_1 has a velocity of about 12·5 kilometres per second, V_8 would be about 2 kilometres per second, and V_{20}, if there is such a value, would be less than 0·5 per second, *i.e.* if all these phases of earthquake motion started from an origin at the same time. We fear that many seismologists will not readily accept this hypothesis, and to explain the rising and falling in amplitude and changes in period exhibited in teleseismic writings will require some other assumption. P_1, P_2, P_3, and their corresponding velocities, are explicable by the existence of three types of waves, but the lengthening of the caudal appendage of a megaseism as it travels into and sometimes beyond its quadrantal region is a phenomenon about which many explanations have been offered, but the one to be accepted does not appear so far to have been decided on.

In his conclusion to this section, Dr. Negri says that the relation of $\frac{V_1}{V_2}$, $\frac{V_1}{V_{31}}$ (*sic*), $\frac{V_1}{V_5}$, &c., represents a series in increasing arithmetical progression. All that the majority of seismologists at present recognise is that in round numbers V_1 equals 12 kilometres, V_2 equals about 6 kilometres, and V_3 about 3 kilometres per second, and we fear that they are not yet in a position to accept values which might correspond to P_{20} or P_{40}. In an appendix the author shows that his acquaintance with modern seismology is rather one-sided. He gives a bibliography of 176 books and papers, nearly all of which are in the Italian or Spanish language. Japan is credited with thirteen papers, England with five, whilst two or three are in French. The first exhibition of seismological instruments, we are told, was represented by a section in the International Exhibition of 1900 in Paris. The exceedingly popular exhibition of earthquake instruments held in Tokio twenty years earlier is not even mentioned. The author concludes his memoir by two queries: Why do not all the students of seismology in South America combine? Why does not the national authority do something to bring about this union, which would be for the good and progress of science in general? It is my prophecy, says Dr. Negri, that these desires will very soon become realised. JOHN MILNE.

[1] "Velocidad de Propagición de las Ondas Sismicas." By Dr. G. Negri. Traducción de Alfredo Torcelli. Pp. 143. (La Plata: Observatoria Astronomico, 1911.)

PROF. GEORGE CHRYSTAL.

THE lamented death of Prof. George Chrystal, of Edinburgh University, removes an outstanding personality in academic and educational circles. Aberdeen and Cambridge claim him as a distinguished alumnus. In 1875 he was bracketed with Prof. Burnside as Second Wrangler and First Smith's Prizeman. Even then he showed his leaning towards applied rather than pure mathematics; for Prof. Tait, who was one of the examiners, used to say that Chrystal excelled all the others in the way in which he solved physical problems.

After two years as professor of mathematics in St. Andrews University, Prof. Chrystal in November, 1879, began his life's work as occupier of the like chair in Edinburgh. The nature of his work compelled him to give his best mind to the teaching of mathematics and the training of the mathematical teacher. In those days every student of arts had to graduate in the same seven subjects. There were no options. Even the comparatively mild problem-solving mathematics of the old school, of which Kelland had been a shining light, had made many a man of classical and philosophical attainments tremble as he entered the examination hall and sat down to tackle the algebra or the Euclidean geometry paper. But the first year of Chrystal's professoriate struck terror to their hearts. Keen, rapid, logical, full of suggestions as to higher fields of mathematical delights, Chrystal transformed the whole atmosphere of the class-room. Eagerly the mathematical minds followed his fascinating lead; despondingly and despairingly those not so gifted fell hopelessly behind, faintly perceiving, if at all, the finely knit sequence

of ideas which formed the thread of his discussions. These, sad at heart, thought simply of their degree, and wondered how they were going to surmount the mathematical barrier. Chrystal had far other conceptions in his mind; but with all his strenuous and successful labours to raise the standard of mathematical teaching he was essentially just, and knew well that minds of the highest quality are not always able to appreciate the convergency of series or the mysteries of probabilities. When the time for testing came, the really intelligent, hard-working student got full credit for his limited mathematical powers.

It was a great pleasure to see in these early days the enthusiasm of the mathematical students, for whose sakes Chrystal never spared himself. The "coaches," all alive to the necessities of the situation, quickly got hold of the methods; and as the graduates passed out into the schools they carried with them the mind of their master. To Chrystal, more than to any other, the great development of mathematical teaching in the schools may be traced.

From the first, as Tait never failed to remind us, Chrystal's was essentially a physical mind. As a Cambridge undergraduate he had—as some thought—"wasted" his time with Maxwell in the Cavendish Laboratory, fiddling with wires, when he should have been practising the writing out of problems. His careful investigation into the truth of Ohm's law is a standard piece of work showing clear perceptions and careful manipulation. The articles on "Electricity" and "Magnetism" in the ninth edition of the "Encyclopædia Britannica" contain in a wonderfully small compass the very best up-to-date account of these sciences, both theoretical and experimental, ever put together. Had they been printed in book form a few years after their first publication they would have been the *vade mecum* of the advanced student. Their merits are a clear, flowing, forceful style, and a remarkable discrimination in selecting material. The great advances of the last twenty years have been along the lines clearly indicated in these articles. On coming to Edinburgh, Chrystal, though he gave his principal attention to his real class work, did not allow his physical work to fall behind. There was no summer session in those days; and the summer months which most other professors spent in holiday were spent by Chrystal in Tait's laboratory. Here he brought to full fruition his theory of the differential telephone. His paper on the subject is published in the Transactions of the Royal Society of Edinburgh, and constitutes the first truly scientific discussion of the action of the induction-balance.

Outside his own particular experimental work, Chrystal was an ever-present source of inspiration to the students. Several of the investigations which were carried through in Tait's laboratory during the early 'eighties were suggested by Chrystal, who really acted the part of a second professor of natural philosophy. With the increasing care of his own department, he was compelled after a few years to give up his experimenting. Another reason, as he once expressed it, was that he found he was usurping the use of all the best instruments in the place, so that the students were not able to get their best work done.

The personality of Prof. Chrystal soon made itself felt on board and senate. He was elected a vice-president of the Royal Society of Edinburgh in 1887, at the unusually early age of thirty-six. For two terms of six years he filled the same important post, and, in 1901, on Prof. Tait's death, he was chosen general secretary. The duties of this office he performed in a manner which it is impossible to praise too highly. Only a man of Chrystal's alertness of mind, clearness of vision, knowledge of affairs, fair-mindedness, and yet determination to have the society's rights recognised, could have successfully manœuvred the society through the time of strain when its status and efficiency were threatened. The Scottish members of Parliament stood loyally by the society, and by their sympathy more was achieved than was at first hoped for. Through all the cross-currents of opinion, it was Chrystal who was the real steersman. The present habitation of the Royal Society of Edinburgh is a lasting monument to the memory of its general secretary, who secured from the Government of the day a generous recognition of the claims of science.

The same keen personality combined with business faculties of a high order made Chrystal the right man in the right place, when in 1891 his colleagues elected him the dean of the faculty of arts. The new ordinances which came into effect at that time were soon found to be hampering and unworkable in the interests both of teacher and pupil. Strenuously Chrystal applied himself to the reorganisation of the whole arts curriculum, and the reward of his labours he lived to see in the sanctioning of a new ordinance which grants autonomy to each university within reasonable limits.

To these administrative duties he added for some years the chairmanship of the Provincial Committee for the Training of Teachers. He was, in fact, the first chairman, and probably did more than any other single man to mould this committee into a serviceable administrative body. He was also for several years a member of the committee appointed by the War Office to advise the Army Council regarding the preliminary education of officers.

With all this administrative strain, Chrystal continued to develop his department of mathematics to greater and greater effectiveness. His text-books on algebra are well known; but it is not perhaps so well known that he was the inventor of the very appropriate phrases the "freedom equations" and the "constraint equation" of a curve. These show again how his mind moved in dynamical regions.

Chrystal's literary output is perhaps smaller in quantity than that of most men of equal reputation; but the quality is high. He communicated to the Edinburgh Mathematical Society an admirable account of the properties of lenses and doublets, to the study of which he was led in his recreation as a photographer. He was very skilful in all photographic manipulation, his attachment to the art dating from his Cambridge days, when dry plates were unknown.

In addition to several mathematical papers in the Proceedings and Transactions of the Royal Society of Edinburgh, he enriched the science of hydrodynamics by his researches on seiches. His attention was directed to the subject by Sir John Murray, and the whole problem, experimental and theoretical, seized hold of his mind in a marvellous way. This recent work is too well known to need discussion now. Not only did he vastly improve the mathematical theory of these movements in lakes and bays, but he invented instruments and obtained records which shed a new light on the whole set of phenomena. The work is stamped with all the thoroughness and ingenuity of a fine intellect.

What Chrystal undertook to do he did to the utmost of his powers. He left no ragged ends. All was carried through with celerity, yet with thoughtfulness and accuracy. Quick in his apprehension, and impatient of humbug, he was a terror to the student who was not an honest seeker after truth, but to the genuine student he gave of his best, and nothing delighted him more than when a pupil showed originality and power of research. His knowledge of human affairs was wide and deep. He was splendid

company among congenial friends, and in his own home he was the best of hosts. He was remarkably regular in his attendance at the meetings of the Royal Society Club, and there his appreciation of a good story and his own powers as a raconteur were always in evidence. Like most Scotsmen, he was reserved in his expression of the deeper feelings, but his sympathies were true and his friendship staunch.

C. G. KNOTT.

NOTES.

HIS MAJESTY THE KING has been pleased to approve of the following awards this year by the president and council of the Royal Society:—a Royal medal to Prof. George Chrystal, Sec.R.S. Edinburgh, for his researches in mathematics and physics, especially his recent work on seiches and free oscillations in the Scottish lakes; and a Royal medal to Dr. W. M. Bayliss, F.R.S., for his researches in physiology. The following awards have also been made:—the Copley medal to Sir George H. Darwin, K.C.B., F.R.S., for his scientific researches, especially in the domain of astronomical evolution; the Davy medal to Prof. Henry E. Armstrong, F.R.S., for his contributions to chemical science; and the Hughes medal to Mr. C. T. R. Wilson, F.R.S., for his investigations on the formation of cloud and their application to the study of electrical ions.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the year 1912 at the anniversary meeting on November 30:—*President*, Sir Archibald Geikie, K.C.B.; *treasurer*, Mr. Alfred Bray Kempe; *secretaries*, Sir Joseph Larmor and Sir John Rose Bradford, K.C.M.G.; *foreign secretary*, Sir William Crookes, O.M.; *other members of the council*, Lieut.-Colonel A. W. Alcock, C.I.E., Prof. W. H. Bragg, Sir A. H. Church, K.C.V.O., Mr. L. Fletcher, Prof. J. S. Gardiner, Mr. W. B. Hardy, Prof. M. J. M. Hill, Prof. F. S. Kipping, Mr. H. R. A. Mallock, the Duke of Northumberland, K.G., Sir Ronald Ross, K.C.B., Prof. E. Rutherford, Prof. S. P. Thompson, Prof. Sir J. J. Thomson, Mr. H. W. T. Wager, and Prof. E. T. Whittaker.

A REUTER message from Stockholm states that the Swedish Academy of Science has decided to award the Nobel prize for chemistry to Mme. Curie. Prof. W. Wien, professor of physics in the University of Würzburg, is to receive the prize for physics. The value of each prize this year is 7773*l*.

WE regret to see the announcement of the death of Mr. John Brown, F.R.S., of Longhurst, Dunmurry, Belfast, on November 1, at sixty-one years of age.

THE Physical Society's annual exhibition will be held on Tuesday, December 19, and will be open both in the afternoon and evening.

THE Berthelot memorial lecture of the Chemical Society will be delivered by Prof. H. B. Dixon, F.R.S., on Thursday, November 23.

THE eighty-sixth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Dr. P. Chalmers Mitchell, F.R.S., secretary of the Zoological Society, his subject being "The Childhood of Animals."

THE death is announced of M. E. F. André, whose works in landscape gardening are widely known in the horticultural world. Among various books of which he was the author are "L'Art des Jardins," 1879, with numerous plates and more than 500 illustrations in the text, and a volume on the bromeliaceous plants collected in Colombia, Ecuador, and Venezuela. For nearly thirty years he edited *La Revue Horticole*, which has always held a high place among botanical periodicals.

THE Royal Geological Society of Cornwall at its annual meeting on October 31 presented the Bolitho gold medal to Mr. Clement Reid, F.R.S., in recognition of the able and conscientious manner in which he had superintended, during the past ten years, the geological resurvey of the county, the final memoirs of which are in the press. Mr. Reid, in returning thanks, said that the work done has widened the horizon and opened up new possibilities for Cornish geologists; but there is still a great deal to be done.

THE Royal Society of Arts will begin its 158th session on Wednesday, November 15, with an address from Lord Sanderson, G.C.B., the chairman of the council. Five meetings are announced before Christmas, at which papers will be read on the industrial progress of America, by Prof. James Douglas; the efficiency of the aëroplane, by Mr. A. E. Berriman; British Guiana, by Mr. J. A. J. de Villiers; London transport, by Mr. W. Yorath Lewis; and Bengal fisheries, by Dr. J. Travers Jenkins. Four Cantor lectures on "The Carbonisation of Coal" will be delivered by Prof. Vivian Lewes, and two juvenile lectures on "Soap Bubbles" will be given in January by Mr. C. V. Boys, F.R.S. A long list of papers for the meetings to be held after Christmas is also published.

THE winter session of the British Fire Prevention Committee was commenced on November 1 with a meeting to conduct a series of fire tests dealing with a small hand extinguisher intended to put out electrical and petrol fires. There was a large attendance at the committee's Regent's Park Testing Station, the Earl of Londesborough, K.C.V.O., Mr. Alexander Siemens, and Mr. Edwin O. Sachs, members of council, receiving the visitors, among whom were leading officials concerned in fire matters from the War Office, Board of Trade, and other public departments. There will be another series of tests this month dealing with the flannelette question, which is of such importance to child life; and in December some fire-resisting doors and partitions from the United States will be under investigation.

AUTHENTIC details of the recent Wright gliding experiments are now to hand, from which it appears that the machine used was very similar to a recent type of Wright aëroplane with power. The glider had no front elevator, but an elevating tail placed 12 feet in the rear of the trailing edge of the main planes. The dimensions of the main planes were 32 feet by 5 feet respectively, with a smaller camber than that used in the powered machine. Otherwise the only alterations made were to increase the size of the vertical rudder in the rear and to cut down the length of the skids. With this glider Mr. Orville Wright, starting from one of the sand-hills near Kill Devil Hill, twice succeeded in remaining in the air for rather more than 1m. 25s. The height of the hill from which he started was 75 feet. With regard to the automatic stability device which is stated to have been tried, no details are yet available. The objects of the gliding trials were to decrease the head-resistance of the machine, and incidentally to solve in a practical manner several problems in wind pressure.

BY the death, at the age of seventy-one, of Mr. W. Irvine, a retired member of the Indian Civil Service,

Oriental studies in this country have suffered a grievous loss. Mr. Irvine during a long and distinguished service in India acquired a singularly wide knowledge of the vernacular languages and of Persian. He was one of the few scholars who devoted himself to the history of the later Mogul period. His published work largely consisted of papers contributed to the Journal of the Royal Asiatic Society and other periodicals devoted to Oriental learning. These displayed his wide acquirements in history and philology, and his generous sympathy with India and her people. His more important works were an elaborate account of the armies of the Moguls, and an admirable edition of the famous "Storia do Mogor," or Mogul India between 1653 and 1708, the record of his journeys and experiences by the Venetian traveller, Niccolao Manucci, which was published in four volumes in the Indian Text Series.

THE protest recently made by Lord Curzon against the action of the Indian Government in proposing the suppression of the Central Department of Archæology was strongly supported in these columns and by the numerous scientific bodies and individuals in this country who are interested in the preservation of historical monuments and the excavation of ancient sites. In addition, it has been shown conclusively that the work of the department had commended itself to the native princes and to all classes of the population who look back with pride upon the splendid buildings—the work of vanished races and dynasties. In the course of the debate on the subject, raised by a motion from Lord Curzon on November 3, the Secretary of State, the Marquess of Crewe, announced that while the Government agreed with the contention of the Government of India that the proposed reorganisation would not necessarily put an end to the work of conservation and excavation, he, as representing the Council of India, took the view "that it is necessary to retain the central department for advice, for general supervision, and for the collection of information in connection with archæology." This satisfactory result of the controversy, for which all students of art and history are indebted to Lord Curzon, will be received with general approbation.

THE "Uto" photographic paper of Dr. J. H. Smith, which when exposed under a coloured transparency would furnish a coloured copy of the transparency, was referred to in these columns two or three years ago when it was placed on the market. For some time past it has been unobtainable; and it was known that Dr. Smith was seeking to perfect it. The Société Anonyme Utocolor of La Garenne-Colombes, Paris, is now introducing an improved paper under the name of "Utocolor-paper," which embodies the results of Dr. Smith's investigations. The new paper is stated to be much more rapid than the old, and it is free from the odour of anethol, the sensitiser previously employed. The gelatinous coating of the paper contains three dyes, red, yellow, and blue, which are bleached by exposure to light; and if a coloured light is employed, the dye, or mixture of dyes, that matches the colour of the light survives longer than the other dyes, which absorb the light, and therefore a coloured original is reproduced. The exposure necessary to copy an autochrome is about two hours of direct sunshine, or several hours of good diffused light and one hour of sunshine to finish it. Coloured light-filters are supplied, and one or both of them are placed over the frame during the exposure. They serve to absorb the ultra-violet and adjust the comparative colour intensities. The paper after exposure is desensitised, or "fixed," and the prints may then be kept in a feebly lighted room for a considerable time without obvious change; and in the dark, as in an album, they may be regarded as practically permanent.

THE recently founded Prehistoric Society of East Anglia has issued the first instalment of its Proceedings for 1908–9 and 1909–10. It is mainly devoted to inquiries and speculations regarding certain types of flint implements found by the president, Dr. W. Allen Sturge, and his fellow-members. He remarks that "not only is our district of East Anglia one of the richest in the world for the older Palæolithic remains, but it is probably the richest—I might perhaps go further and say incomparably the richest—in the world in Neolithic remains." The work of such a society will be welcomed by all students of prehistoric man and his culture. Dr. Sturge's essay discusses in detail the peculiarities in the types of implements which he has discovered. These lead him to attribute to them a higher antiquity than is recognised by other authorities. At any rate this essay, which is well provided with illustrations, deserves serious attention.

DR. REDCLIFFE N. SALAMAN contributes to *The Eugenics Review* for October an interesting paper entitled "Heredity and the Jew." Of the ancient race he observes that it is unlikely that any people residing in the centre of the great highway of the Old World, as did the Jews and their neighbours, should have, at any time, maintained a biological purity as we understand it in the animal and plant world. Proceeding to discuss certain cases of mixed marriages between Jews and Gentiles, he arrives at the conclusion that "the Jewish facial type, whether it be considered to rest on a gross anatomical basis or whether it be regarded as the reflection in the facial musculature of a peculiar psychical state, is a character which is subject to the Mendelian law of heredity." The obvious criticism is that the materials are too scanty to warrant this conclusion. The paper, however, suggests an interesting field of inquiry, which the writer might with advantage study on a wider scale.

AT a recent demonstration given by Prof. A. Keith at the Royal College of Surgeons, Lincoln's Inn Fields, a series of preparations were shown which illustrate the remarkable growth changes which occur in the bodies of those suffering from acromegaly. Not only was the skeleton affected by a peculiar form of overgrowth, but so were the muscles, the viscera, the joints, the heart, and the lungs. Even the coats of the appendix were increased. Many of the features of the skeleton recalled those of Neanderthal man. The great enlargement of the ribs, sternum, and clavicles produced a thorax which had many points in common with that of the gorilla. The pituitary body was greatly enlarged. It becomes more evident, as our knowledge of acromegaly is extended, that the pituitary body has a profound influence on the growth of the body. It is generally recognised that it coordinates in some manner the growth of the skeleton and muscles, but it is becoming manifest that it also influences the other systems of the body. A great development of these bones and muscles would be useless to the individual unless there was a corresponding hypertrophy of the heart, lungs, and of the viscera connected with nutrition. The preparations added recently to the College of Surgeons Museum show that all these systems are affected. One of the preparations illustrates a very remarkable structural change. In the subject of the disease, a male, the pelvis had assumed by a process of growth all the characters of the female pelvis

DR. F. NANSEN, G.C.V.O., lectured before the Royal Geographical Society on the Norsemen in America on November 6. The preparation of a short account of Arctic exploration had led him to review the whole of the evidence for the early voyages of the Norsemen, and resulted in views which differ considerably from those that are current. He agrees that the attainment of the shore of America by the Norsemen is certain, but maintains that the accounts of their voyages as we find them in the Icelandic sagas is at least in part legendary. Though Greenland, Helluland, Markland, and Wineland were discovered at the end of the tenth and the beginning of the eleventh centuries, the earliest written saga treating with these voyages was written between 1270 and 1300. He attributes the details of the self-grown vine and the unsown corn (or wheat) to interpolations and additions taken from earlier writings, such as those of Isidor Hispalensis from the seventh century, when writing of the Fortunate Islands in the Atlantic west of Africa. The same ideas in very similar words are seen to occur in the early Irish writings. His conclusion is that the whole narrative of the Wineland voyages is a mosaic of one feature after another gathered from east and west, among which we find many features, however, which indicate a certain knowledge of the real conditions on the north-east coast of America.

AT the conclusion of an article on the habits of the Amazonian ant *Polyergus rufescens*, published in vol. xxxi., p. 695 (October), of *Biologisches Centralblatt*, Prof. C. Emery states that the foundation of a new colony of this species is doubtless due to one or more fertilised females effecting an entrance into a nest of *Formica fusca* or one of its subspecies. The intruding female, unless she be stopped by hostile workers, immediately makes her way to the domicile of the reigning queen, whom, when found, she attacks and eventually kills with her powerful mandibles. During the contest the attendant workers remain stupefied with fright, but at the death of their legitimate queen quickly receive the foreign female in her place. In the second year the new queen lays eggs, from which emerge polyergus-workers, and these eventually obtain the mastery of the nest.

THAT certain fishes, such as salmon, which ascend rivers or streams for spawning assume two, or rarely three, distinct phases has long been known; and in a recent issue (vol. vii., part v.) of *Annotationes Zoologicae Japonenses* Prof. S. Hatta shows that the same thing occurs in the lesser Japanese river-lampern (*Lampetra mitsurikii*). Males and females of this species are readily distinguished by the much greater development of the anal fin in the latter than in the former; and as representatives of each sex are found in both a large phase, which attains a length of about 8 inches, and in a small phase, in which the length is less than half this, it is manifest that the species is dimorphic, especially as the two phases are found in one and the same stream, and do not intergrade.

A SERIES of nine associated human teeth discovered in a stratum of Mousterian age in a cave at St. Brelade's Bay, Jersey, are referred by Messrs. Keith and Knowles, in the October number of *The Journal of Anatomy and Physiology*, to the Neanderthal race. In spite of the slight degree in which the cusps are worn, the pulp-cavities of several of the teeth were found to be filled with secondary dentine. This and the size of the roots the authors regard as characteristic of Neanderthal teeth. Other primitive features are noticeable in the canine and first lower premolar, which (in contrast to what obtains among modern races) is larger than the second, in consequence of having to serve as an opponent to the upper canine.

WITH the view of illustrating normal variations in form and size of chromosomes, Dr. C. E. Walker figures, in a note received as a separate abstract from *Archiv für Zellforschung* (vol. vi., part iv.), certain changes observed during the meiotic division in cells of the generative organ of Triton and Lepidosiren. Arising therefrom, the argument is formulated that if the chromosomes are the bearers of individual variations, the differences in form and size may be correlated with the fluctuating variations recognised by Darwin.

A REPORT on official investigations regarding "beech coccus," *Cryptococcus fagi*, conducted by Mr. L. A. Boodle and Mr. W. Dallimore, is published in the *Kew Bulletin* (No. 8). Personal observations were made in woods in Buckinghamshire and Berkshire. The evidence is not thoroughly conclusive, but the investigators express a definite opinion that the beech coccus is not the destructive agent as generally supposed, and implicate the two fungi *Nectria ditissima* and *Melogramma spiniferum*, both of which were universally found on the unhealthy trees. Another article in the *Bulletin*, of considerable interest to gardeners, is the note on peat-moss litter manure, in which it is stated that the material is neither true peat nor moss, and is extremely undesirable in gardens, being injurious unless it has been allowed to rot for two years at least; the injurious action is attributed to the excess of organic acids contained.

As a practicable study in the evolution of a land-form and its plant covering, Dr. L. Cockayne describes, in a contribution—of which a separate copy has been received—to the Transactions and Proceedings of the Botanical Society of Edinburgh (vol. xxiv., part iii.), the series of events which have led to the colonisation of the subalpine river-bed of the Rakaia, in the southern Alps of New Zealand. The climatic conditions point to an excess of rain, neutralised by insolation, frost, and high winds, while controlling edaphic factors are supplied by the porous soil and glacial water, so that the early colonists must be able to endure severe ecological changes. The first stages in colonisation are supplied by *Epilobium melanocaulon*, a plant provided with light, rapidly germinating seed, and the mat-forming *Raoulia tenuicaulis*. On situations raised above floods these are reinforced by a crustaceous lichen and other species of Raoulia, notably *R. Haastii*, which serves as a nidus for various less hardy colonists. A steppe association, distinguished by the presence of Raoulia and tussock grasses, and scrub are subsequent stages.

IN all new countries it is necessary to discover new crops in order that the system of agriculture should be diversified as much as possible, and particularly is it desirable to introduce leguminous crops. In a recent issue of *The Agricultural Journal of the Union of South Africa* experiments are reported showing that the soya bean is likely to prove advantageous wherever maize is of great importance. The crop is not only valuable in itself, but it leaves nitrogenous residues in the soil that add materially to the fertility. The seeds are rich in oil, for which there is a considerable demand by soap-makers and others, while the residue left after partial extraction of the oil furnishes useful cattle food.

As a reply to the statement, formulated in a memorandum issued by the U.S. Weather Bureau, questioning

whether it can be shown that deforestation has augmented droughts and floods, an article is published in *The Indian Forester* (September) citing data and observations to prove that forests do exercise a marked influence on the regulation and maintenance of water supplies. The evidence submitted falls under three heads. First, deforestation produces a diminution or cessation of flow in the streams; most of the examples quoted belong to this category. Testimony from Monroe, Wisconsin, affirms that in seventy years the forest region has been reduced from 83 to 6 per cent.; coincidently, streams have dried up entirely, and mills have ceased to operate. Secondly, reafforestation leads to an increased water supply. An instance from Burma is noted, according to which renewal of the forests on Popa Hill, Myingyan, has averted the periodic drying up of the streams. Thirdly, corroborative conclusions are derived from a comparison of the flow in neighbouring streams, fed in one case from protected, in the other from denuded, catchment areas.

THE Board of Agriculture issues leaflets calculated to serve a very useful purpose by giving information to farmers on such problems as plant diseases, crop management, and manures. The leaflets are short, concisely worded, and where possible illustrated. Some of the recent issues deal with bacteriosis of the potato and tomato; actinomycosis in cattle, a disease caused by the growth on the animal's tongue of the parasitic fungus Actinomyces coming from grasses, cereals, or the soil. Another leaflet deals with the three weed grasses *Triticium repens*, *Agrostis vulgaris*, and *Arrhenatherum avenaceum*, all described by the farmer as couch or twitch; whilst a third gives an account of the composition of seaweed and its use as manure.

THE eleventh annual report of the Midland Agricultural and Dairy College shows that the members of the staff are responding in a splendid manner to the demands made on them by students and farmers. The principal says of one of the departments: "Every use has been made of the time and facilities that are available, and often leisure that ought to have been spent in recreation has been devoted to extra work," a statement fully borne out by the separate reports from the individual members of the staff. The Board of Agriculture has increased the grant to the maximum of 1000*l*., but more space seems to be needed in several departments. Favourable reports were sent by the examiners, except only in one instance, and there a perusal of the examination questions shows that the fault lies with neither students nor staff.

THE summary of the weather for the week ending November 4, issued by the Meteorological Office, shows that the conditions were very stormy throughout the period. Several large and important storm areas arrived from the Atlantic and extended over the British Islands and their neighbourhood. Severe gales were experienced on several days during the week, and on Saturday, November 4, the barometer at Thorshavn fell below 28·0 inches as the central area of the storm traversed Færöe. The rainfall for the week exceeded the average in all districts except in the north-east of England and in the English Channel. In the west of Scotland the measurement was 3·89 inches, which is 2·59 inches more than the average, and in the north of Scotland the excess was 2·29 inches. The aggregate rainfall for the nine weeks of the present autumn is now in excess of the average in the south-east and north-west of England, in the English Channel, and in the south of Ireland, whilst the deficiency in other districts is being greatly lessened by the recent heavy rains. At Greenwich the rainfall for October was 3·29 inches, which is 0·44 inch more than the average of the past sixty years; and October was the wettest month since November of last year.

AMONG several useful papers in the Journal of the Meteorological Society of Japan for August is one, by Mr. Y. Tsuiji, on earth temperature at Taihoku (Formosa), based on eleven years' observations (1897–1907). The surface layer of the ground is clay, and underground water is met with at a depth of about 20 feet. The tables show that the average annual air temperature is 21·54° C., and at the surface of the ground 23·55°; at 0·5 metre the mean is 23·39°, at 1 metre 23·31°, at 3 metres 23·11°. The mean decreases with depth, while the rate of diminution also becomes smaller as the depth increases; the annual range diminishes with increase of depth, while the epoch of extreme temperature is retarded. The author submits the results to harmonic analysis, and remarks that they show that if we are satisfied with a rough determination of the mean values for practical use, there is no need for that laborious process adopted in modern meteorology.

IN *The Cairo Scientific Journal* for September details are given of a slight earthquake shock which was felt in Cairo on August 22 at 10h. 23m. east European time. It was characterised by the very rapid character of the vibrations.

IN *Petermann's Mitteilungen* for October the results of the census of Mexico taken in October, 1910, are discussed and presented in a map which shows the distribution of population density. The northern portion to the north of lat. 25° is scantily peopled, having a population of from one to three to the square kilometre. The most densely peopled region is in the central part by Mexico, where a small portion is shown as having 480 inhabitants per square kilometre.

WE have received a catalogue of surveying and drawing instruments made by Messrs. C. F. Casella and Co., Ltd., of 11 Rochester Row, London, S.W. Besides the usual types of instruments, this firm constructs several of a special character, and full descriptions of some of these are given in the catalogue. Among these we may note Reeves's tangent micrometer for use on sextants and theodolites; Reeves's distance-finder alidade, in which the 3-foot alidade rod can be utilised as a distance finder, so that when used on a plane table the distance of objects can be determined either by intersection or by direct measurement. Hepworth's electric artificial horizon is a simple attachment by which, when a line on the horizon glass is in alignment with the eye of the observer and the natural horizon, the observer is notified by an audible signal, so that the use of the sea-horizon is no longer necessary, and observations can be taken when fog or mist may obscure the horizon.

THE Journal of the Franklin Institute for October contains an abstract of a paper on the *rôle* of water in minerals, by Dr. W. W. Coblentz, of the Bureau of Standards, Washington, which gives an account of a method of investigating the question which seems likely to furnish more definite information than has been available in the past. Dr. Coblentz examines the infra-red absorption spectra of a number of minerals having water of crystallisation by means of a vacuum bolometer and a mirror spectrometer. He finds that in some cases the absorption spectrum of the crystal is not, while in other cases it is,

the superposed spectra of the anhydrous substance and water. The water in crystals of the first class he proposes to call "water of constitution," and in the second "water of crystallisation." The latter term would thus include water which has in the past been known as "water of crystallisation," "dissolved water," and "water of solid solution."

THE diurnal variation of magnetic declination at Kiel is discussed by L. Weber and H. Borchardt in a paper in Heft 1, Bd. xv., of the *Naturwissenschaftlichen Verein* for Schleswig-Holstein. The data, derived from a magnetograph of special construction, extended—with two or three short interruptions—from January, 1902, to September, 1910. The range of the regular diurnal variation in individual months varied from 2·8′ in December, 1905, to 12·8′ in July, 1906; while the range of the mean diurnal inequality for the year varied from 6·63′ in 1909 to 8·46′ in 1905. At the end are curves showing the diurnal variation for the twelve months of the three years 1907 to 1909 treated individually, and for the twelve months of the seven years 1903 to 1909 combined, as well as the mean diurnal variation for the year from the last-mentioned period.

THE recent study of white plumage and hair coloration has led to the interesting conclusion that there are two varieties of white, one of which is dominant and the other recessive. These are indistinguishable to the eye, but exact opposites from the breeder's point of view. Dr. R. A. Gortner, working in the biochemical laboratory of the Carnegie Institution, has shown recently (*Journal of Biological Chemistry*, September) that dominant whites do not contain a melanin which is lacking in the recessive whites; he attributes dominant whites to the presence of a factor which inhibits pigment formation. His experiments prove that the oxidation of tyrosine by tyrosinase is prevented by the presence of aromatic phenols, which contain two hydroxyl groups in the meta position to each other, such as resorcinol, orcinol, or phloroglucinol. These phenols do not inhibit other oxydases than tyrosine. It is supposed that in dominant whites such an inhibiting factor is present, whereas the recessive whites lack enzyme or chromogen or both, and also lack the inhibiting factor.

Engineering for November 3 comments on the report of the commission appointed to inquire into the cause of the *Liberté* explosion, which has now been made public. Briefly, the report states:—(1) That it was not due to an act of malevolence. (2) That it was not due to a fire having occurred in any of the spaces adjoining the magazines. (3) That it was due to the inflammation of a cartridge of service powder in one or other of the forward starboard magazines containing only powder from one lot—namely, lot BM_{13} AM_8 2·06 P.B.—*i.e.* the second lot of powder manufactured in 1906 at the Government powder factory of Pont-de-Buis. The commission hesitates to attribute the cause to "spontaneous combustion" of the powder. Among other recommendations, the report states that the recent order lowering to four years the limit of age allowed for powders stored on board will be, without doubt, for a long time yet one of the most efficacious guarantees of safety against the instability of "B" powders; in foreign navies the limit of age is even lower.

OUR contemporary points out that British cordite is tested as soon as possible after it becomes eight years old, and though inspection is made twice yearly of all cordite, it is clear that it is expected to last at least eight years. Germany and Italy both use nitro-glycerine powders for their navies, which, so far as is known, have been immune from trouble as regards powder. Possibly the United States regulations are referred to, since the U.S. Navy use a nitro-cellulose powder—*i.e.* the same type as the French Navy. *Engineering* holds that the report confirms its already published views that, for naval purposes, the nitro-cellulose type of propellent powder is vastly inferior, both chemically and ballistically, as compared with the nitro-glycerine type. Indications are not wanting that the U.S. Navy may have to deplore a similar disaster, as it has lately adopted the course of "reworking" its "old" powders, some of them only a couple or so years old, with so-called stabilisers. These may have their uses when added to newly made powders; but to add them to powders which have already shown themselves to be unstable, from the fact that they are sentenced to be reworked, is a dangerous expedient which no economic consideration can excuse.

MR. W. MARTINDALE, New Cavendish Street, London, W., has issued a new complete price-list of apparatus, chemicals, and appliances generally suitable for scientific chemists and medical practitioners. The catalogue runs to 182 large pages, is well illustrated, and arranged in a form handy for reference.

MANY valuable works—old and new—are included in a catalogue of second-hand books on meteorology and terrestrial magnetism just issued by Messrs. H. Sotheran and Co., 43 Piccadilly, W. Brief notes are given describing the characters of most of the books. The catalogue includes also a collection of works on airmanship, and a supplement of cognate periodicals and publications of learned societies.

AN illustrated supplement, 1911, to the catalogue of scientific apparatus issued in 1910 by Messrs. Heynes Mathew, Ltd., of Cape Town, serves to show, incidentally, the satisfactory way in which the teaching of science is being developed in South Africa. The science teachers in South African schools are now able to obtain locally the equipment and material necessary for their work. The present list shows that this firm is in a position to undertake the complete furnishing and equipment of laboratories.

THE *Revista Tecnica del Ministerio de Obras Publicas* of Venezuela for September contains a note on the calculation of geographical coordinates and azimuths for a geodetic triangulation on which a physical and political map of the country may be based. The values for Clarke's ellipsoid of 1866 are used, and the Coast and Geodetic Survey of the United States is followed for the logarithms of the different constants involved in the computations.

AMONG notices of forthcoming scientific books which we have received during the week may be mentioned the following:—Messrs. Methuen have in the press a book by Mr. R. Lydekker, F.R.S., entitled "The Ox and its Kindred." Commencing with a discussion as to the proper English name of the domesticated animal, the author gives a sketch of the structure and zoological position of oxen, followed by a history of the extermination of the wild ox, or aurochs. Accounts are also given of park-cattle and the chief domesticated breeds of cattle—British and foreign; the book concludes with brief surveys of the wild and extinct members of the group.—Messrs. Kegan Paul, Trench, Trübner and Co., Ltd., are publishing under the title of "North Sea Fishers and Fighters" a work, by Mr. Walter Wood, on the development of the deep-sea

fisheries. The book deals fully with the men of the North Sea, and is embellished with colour and pencil drawings and photographs.—Mr. William Lewis, of Duke Street, Cardiff, is publishing for the Cardiff Naturalists' Society the first volume of "The Flora of Glamorgan," including the spermaphytes and vascular cryptogams, with index. The work has been prepared under the direction of a committee of the Cardiff Naturalists' Society, and is edited by Prof. A. H. Trow.

OUR ASTRONOMICAL COLUMN.

BROOKS'S COMET, 1911*c*.—In addition to the ordinary cometary spectrum, M. Bosler finds radiations at λλ 407, 405, 401, and 399 in the spectrum of the head of Brooks's comet. A longer exposure on September 25 showed also the tail radiations, and it was seen that λλ 401, 425, and 456 extended some 1° 30′ into the tail, while the radiation at λ 470 extended for not more than 30′.

Prof. Iniguez, describing the photographs secured at the Madrid Observatory (*Comptes rendus*, No. 17, October 23), records seven condensations in the spectrum, viz. λλ 555, 514, 472, 440, 423, 410, and 388. But the fourth and sixth are multiple, the wave-lengths of their components being 440, 434 and 432 and 410, 407, 405, 404, and 402 respectively; λ 388 is double.

The comet is still visible near the horizon, south of east, just before daybreak; but, as will be seen from the following ephemeris, by Dr. Ebell, the southern declination is increasing, and the comet, receding from both sun and earth, is becoming fainter:—

Ephemeris 12h. M.T. Berlin.

1911	α (true) h. m.	δ (true) ° ′	log *r*	log Δ	mag.
Nov. 8	12 43·9	− 9 48·9	9·7531	0·0263	3·9
,, 12	12 51·6	−14 10·4	9·7918	0·0558	4·2
,, 16	13 0·3	−18 3·6	9·8317	0·0824	4·5
,, 20	13 9·4	−21 31·7	9·8709	0·1063	4·9

BORRELLY'S COMET, 1911*e*, AND WOLF'S COMET, 1911*a*.—A telegram from Dr. Meyermann to the *Astronomische Nachrichten* announces that Borrelly's comet was observed at Tsingtau on October 20. It was elongated, about 2′ in diameter, magnitude 10, had no tail, and was very indistinct.

M. Kamensky gives an ephemeris, extending to January 2, 1912, for Wolf's comet in No. 4528 of the *Astronomische Nachrichten*. Only four observations of this faint object during the present return have yet been recorded; these give corrections of the order of −0·5s. and −6″ to the ephemeris. Taking the magnitude on June 29·5 as 14·6, as determined from Dr. Wolf's plate, M. Kamensky finds that at no time this year will the comet be brighter than the fourteenth magnitude.

MARS.—M. Antoniadi's observations of Mars with the large refractor at the Meudon Observatory commenced on September 18, and a number of changes have already been noted. Modifications of the colours of various parts of the disc, with an abnormal pallor of the "seas," suggests the presence of yellowish cloud in the Martian atmosphere, such as has been noted at previous oppositions. A large mass of white cloud completely veiled the region of M. Cimmerium, M. Tyrrhenum, and Hesperia on October 14. The complete veiling of so dark an area as M. Tyrrhenum has not been seen since 1888, when the series of observations commenced. The whiteness of Libya on October 11 is attributed to overlying mist, which is transparent when viewed normally, but increases in visibility as the line of vision becomes more oblique, *i.e.* as the area approaches the terminator. A very bright terminator projection, probably due to cloud, was a very prominent feature of the regions north of Icaria from 10h. 56m. to 11h. 25m. on October 14; terrestrial clouds then stopped observations (*Astronomische Nachrichten*, No. 4532).

THE SUN'S ENERGY SPECTRUM AND TEMPERATURE.—In No. 3, vol. xxxiv., of *The Astrophysical Journal* Mr. Abbott discusses the distribution of energy in the sun's spectrum as derived from the spectro-bolometric observations made at Mount Wilson, Mount Whitney, and Washington during 1903–10. He discusses at length the various possible errors and the conditions which might modify, more or less, the derived results. The distribution of energy outside the atmosphere is tabulated, and the energy is shown to reach a sharp maximum at about 0·470 μ; a table of atmospheric transmission coefficients is also given. The results appear to be independent of the observing station, but sensitive to the character of the spectroscope used, and little weight must be given to values for wave-lengths beyond 0·40 μ where glass prisms are employed; a quartz-magnalium system was used latterly.

Mr. Abbott also discusses the question of the sun's temperature, and finds that the sun's effective emission is comparable with that of a "black body" at 6000° C. absolute, although he considers this is modified considerably, and that the actual radiating temperature is more of the order of 7000° C. absolute.

A DAYLIGHT METEOR IN SOUTH AFRICA.—Some accounts of a wonderful meteor, which provided a striking spectacle some time before noon on August 24, are recorded by Mr. Innes in Circular 11 of the Transvaal Observatory. The phenomenon was seen by several persons located near Potchefstroom; but the reports are not strictly in accordance. Mr. Innes suggests the possibility of the several observers having seen portions of a broken-up meteor of such brilliancy as to arrest their attention in full sunlight. Mr. Ingham, chief engineer of the Rand Water Board, estimates that when he saw it the meteor was not more than 400 yards distant, had a head 5 or 6 inches in diameter, and a flame, like that of burning sodium, extending some 12 to 15 feet from the head. No "find" is recorded.

THE PERIOD AND EPOCH OF 68 *u* HERCULIS.—In No. 4526 of the *Astronomische Nachrichten* Dr. Hertzsprung discusses the long series of observations of the variations of 68 *u* Herculis made by J. F. J. Schmidt during 1869–79. He finds for the period 2·051027d., which agrees with the spectroscopic results, and for the commencing epoch of chief minimum, taking the mean of Schmidt's and recent observations, J.D. 2410102·321 M.T. Greenwich. The period shows no apparent variation.

THE ASTRONOMICAL SOCIETY OF BARCELONA.—One of the objects of this society, upon which special stress was laid at its foundation in January, 1910, was the provision of a public observatory where members might meet on fine evenings to study celestial phenomena and to discuss points of astronomical interest. It is pleasant to record that the primary object of the promoters has been realised very unexpectedly, and without cost to the society, in such a manner that within the next few weeks the members will be in absolute possession of a well-equipped observatory. Señor Rafael Patxot y Jubert has offered to present his observatory and instruments to the society, and, needless to say, the offer has been accepted. This establishment, the Observatori Catalá, is situated at San Feliu de Guixols, in the province of Gerona, and in importance stands next to the observatories of Madrid and San Fernando. The whole establishment will be removed immediately to Barcelona, where it will be re-erected on the roof of one of the public buildings.

The instruments include a double equatorial by Mailhat, visual and photographic, with apertures of 8¾ inches and focal lengths of 10 feet and 7 feet 9 inches respectively. A complete set of accessories of precision is included in the gift—spectroscope, micrometer, camera, electric pendulum, and azimuthal theodolite. Annexed to the observatory in its new position will be a room for meetings of the society, library, photographic laboratory, &c. Preparations for the public lunar exhibition, which will be held in Barcelona in May, 1912, are being pushed forward rapidly, and already many promises of assistance have been received from all parts of the world. The exhibition will be held in the University buildings, under the honorary presidency of the rector, Baron de Bonet. The executive council of the society invites the cooperation of seleno-

graphers of all classes in order to make this exhibition, the first of its kind, a success. All communications should be addressed to Señor Don Salvador Raurich, Calle Gran Via Diagonal, 462, 2°, Barcelona, Spain.

THE MAGNITUDES OF EIGHTY-EIGHT STARS IN COMA BERENICES.—In No. 43 (vol. iv., 7) of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowa* Herr Beljawsky gives the resulting magnitudes obtained from the measures of two plates exposed in March last on the Coma Berenices group. The magnitudes were determined by comparison with stars of the Pleiades group, taken on the same plates between exposures on the Coma Berenices group. Comparing his final magnitudes with those obtained by Pickering, M. Beljawsky finds that there is a distinct connection between the difference Beljawsky-Pickering and the spectral class of the stars concerned; the difference increases from class A (0·38) to class K (0·84), and the increase is probably due to a difference in the scale of photographic magnitudes.

THE NEW BOTANICAL LABORATORIES OF THE UNIVERSITY OF MANCHESTER.

THE new botanical laboratories of the University of Manchester were opened by Dr. D. H. Scott, F.R.S., on Friday last, November 3. The new block of buildings consists of four main floors with two mezzanines, and is planned so as to give adequate accommodation for the various branches of botanical science.

For palæobotany, the study of which is so closely associated with the name of the late Prof. Williamson, the first professor of botany of the Owens College, a room is set apart on the ground floor, close to the entrance on the south side of the building; while on the north is a well-lighted laboratory for thirty junior students, connected directly with the larger elementary laboratory in the main building, which is capable of seating forty more students. On the first floor is a large research laboratory, opening into the senior laboratory.

The second floor is devoted entirely to the Cryptogamic Department, which owes its endowment to the munificent legacy of the late Prof. Barker. In addition to providing facilities for researches of a purely scientific nature, the Barker Laboratory will be available for inquiries connected with agriculture, such as investigations into diseases of plants caused by fungi and bacteria.

On the third floor the laboratory for plant physiology occupies the gable end of the building, being designed so as to possess both north light for microscope work and south and west light for experiments requiring direct sunlight. Such experiments can be made either in the laboratory itself or in the greenhouses, which occupy the whole extent of the south front of the top floor. The greenhouses are divided so as to have both a hot and moist and also a cooler and drier portion.

The new botanical block is entirely devoted to laboratory accommodation, and does not contain any lecture-rooms or museum galleries. The facilities for botanical work in the University are added to by the experimental grounds and greenhouses on the Behrens Estate, Fallowfield, which supply both the need of economic botany and zoology. Here experiments in plant breeding have been in progress for some time past, as well as investigations on conditions of cultivation as affecting the development or prevention of certain plant diseases, and the testing of varieties of cultivated plants supposed to be immune to disease.

Photo.] New Botanical Laboratories, University of Manchester. [*E. Vincent Ward.*

At the opening ceremony on Friday, November 3, the Vice-Chancellor (Sir Alfred Hopkinson) welcomed the guests, and after referring to the need there had been for securing adequate accommodation for the teaching of botany in the University, and the steps taken by the council of the University to meet the requirements of the growing department, invited Dr. Scott to open the new building. A ceremonial key was presented to Dr. Scott by the architect, Mr. Paul Waterhouse, and, after the door had been unlocked, the building was declared open, and was inspected by the visitors.

Later in the afternoon Dr. Scott delivered a short address to the friends and students of the University, and spoke

in appreciation of the work of the first professor of botany in the Owens College, the late Prof. Williamson. He directed attention to the fact that during the sixty years which had passed since the foundation of the Owens College there had been only two professors of botany there. Williamson was the first, and the second was the present occupant of the chair, Prof. Weiss. Recalling the facts of Dr. Williamson's life, Dr. Scott reminded his audience of the many-sided character of the former professor of botany, and also specified in detail the work done by Williamson. He took a leading part in bringing home to scientific people the importance of those fossil remains which show structure. Fossil plants are preserved in two quite different ways. On one hand we have the more familiar kind of specimens in the form of casts or impressions which show the external form—often very beautiful—or organisation, but not the structure. On the other are specimens, usually very fragmentary, showing little or nothing of external form, but showing the structure, often beautifully preserved. It was upon the latter form of fossils that all Williamson's later work was done. The fine building now completed is a worthy expression of the progress of the study of botany in Manchester, which has now become one of the greatest centres of botanical teaching in the kingdom.

The ceremony concluded with a vote of thanks to Dr. Scott, proposed by Sir Edward Donner and seconded by Prof. Weiss.

PLAGUE IN EAST ANGLIA.

AFTER a period of quiescence lasting for just over a year, plague has again appeared in East Anglia. Between December 12, 1906, and January, 1907, there were several cases of what was supposed to be pneumonia in two adjoining cottages in the parish of Shotley. There were three cases in one house, two of which were fatal, and five cases in the other, of which four were fatal. It is believed now that all these were cases of pneumonic plague. In January, 1910, two persons died at Trimley, exactly opposite Shotley, on the other side of the River Orwell, from a disease now believed to have been plague. In September, 1910, four persons died in two adjoining cottages in the village of Freston, six miles from Shotley. On October 10 last a seaman was admitted to the sick quarters of the Shotley Royal Naval Barracks, Suffolk, and subsequently developed symptoms of pneumonia. His sputum was examined, and plague bacilli were found. Although there is no certain proof of the source of infection, it is believed he caught the plague from a rabbit he skinned, and that in so doing he cut his finger. This event is not altogether unexpected, as it was known some weeks ago that rats in the Samford Hundred—the district enclosed by the Rivers Orwell and Stour—were again plague-infected; and a vigorous campaign against the rats is being pursued. When the epidemic occurred last year competent authorities warned the Local Government Board of the need for concerted and widespread action for the extermination of rats in the infected district and the delimitation of the infected area.

According to the latest report, the authorities in the Samford district are taking every precaution in the way of destroying rats. As the result of the suggestions of the Local Government Board, it is now proposed that rat-catchers shall be employed in a number of parishes. The public will still receive 2*d.* for every rat killed. Returns of rats killed showed that hundreds were being destroyed in some parishes; in others there were very few to kill. The Local Government Board proposes that concerted action in regard to the plague should be taken by all the neighbouring rural and urban authorities, and it also advises the appointment of a special officer to supervise the destruction of rats. It is to be hoped that, in addition, arrangements will be made for a bacteriological examination of a large proportion of the rats captured, for this procedure is required in order to ascertain the prevalence and area of infection. The rabbits and hares also should be subjected to examination.

CONGRESS OF THE UNIVERSITIES OF THE EMPIRE (1912).

AT a meeting of the Home Universities Committee of the congress, consisting of the Vice-Chancellors of the universities of the United Kingdom and other representatives, held on Saturday, November 4, the programme of subjects for discussion at the congress in July, 1912, was settled.

The meetings of the congress will be held on July, 2, 3, 4, and 5, on four mornings and two afternoons. There will be, in addition, a business meeting.

The subjects for discussion fall under two heads, and are as follows:—

I.—*Universities in their Relation to one another.*

(1) Conditions of entrance to universities and the possibility of equivalence and mutual recognition of entrance tests to degree courses.

(2) Interchange of university teachers; conditions of interchange.

(3) Inter-university arrangements for post-graduate and research students.

(4) Question of division of work and specialisation among universities.

(5) The establishment of a central university bureau; its constitution and functions.

II.—*Universities in their Constitutional Aspects and in their Relation to Teachers, Graduates, and Students.*

(1) The relation of universities to technical and professional education and to education for the public services.

(2) Provision of courses of study and examinations for other than degree students, including university extension and tutorial class work, and specialised courses both of a general and technical character for students engaged in professional, commercial, and industrial pursuits.

(3) The representation of teachers and graduates on the governing body of a university.

(4) Action of universities in relation to the after-careers of their students.

(5) The position of women in universities.

(6) The problem of universities in the East in regard to their influence on character and moral ideals.

(7) Residential facilities, including colleges and hostels.

Upon some of these subjects it is hoped that by cooperation between the universities some action may be possible, *e.g.* such subjects as the extent to which universities may recognise each other's entrance examinations, facilities for post-graduate students from other universities, interchange of professors, &c. There are other questions upon which most, if not all, of the universities will have taken some action and obtained some experience, such as the relationship of universities to colleges associated or federated with them, the position of women in universities, provision for students other than degree students, &c. Upon these questions what is wanted is a summary of the experience of each university presented in a way that will be useful for comparison and will furnish a body of information of permanent value. Accordingly, in addition to the subjects for discussion, other subjects have been selected upon which each of the fifty-one universities is asked to prepare a memorandum. These memoranda will be printed beforehand and issued to members of the congress.

It has been decided that, in addition to the delegates, of which each university is entitled to appoint not more than four, invitations to be present, with the right to speak at the meetings of the congress, shall be issued to a certain number of selected persons. It has been decided that no resolutions will be submitted at the ordinary meetings of the congress, but a special business meeting, confined to delegates of the universities, will be held to deal with executive business. In addition, associate membership of the congress will be open to all who may desire to join on payment of a fee of 10*s.* 6*d.*

BOTANY AT THE BRITISH ASSOCIATION.

TO suit the convenience of members of other sections, the president (Prof. F. E. Weiss) delivered his opening address at twelve noon on Thursday, August 31. The address has already been printed in full in NATURE (September 21, p. 395).

In recent years Section K has frequently shown a

tendency to specialise at particular meetings, *e.g.* in physiology at Dublin. This year an international phytogeographical excursion had been arranged to visit the British Isles during August, and to conclude with the British Association week at Portsmouth. The advent of so many eminent foreign phytogeographers predetermined that the bias of this year's meeting should be ecological. Field excursions, therefore, formed a prominent feature of the programme. The localities visited included Kingley Vale (yew woods), the New Forest (heath, valley-moors, and woodland), Southampton Water (Spartina associations), and Ditcham Park (beech-wood, &c.). In addition to the excursions, there were two discussions and a number of individual papers dealing with phytogeographical subjects. These may be taken first.

The Relation of the Present Plant Population of the British Isles to the Glacial Period.

A joint meeting of botanists, geologists, and geographers was arranged for Monday morning, September 4, the subject under discussion being the relation of the present plant population of the British Isles to the Glacial period.

The discussion was opened by Mr. Clement Reid, F.R.S., who first gave a brief historical summary, and then proceeded to discuss some of the problems which particularly need solution. The first question is, "Are any of our plants survivors that managed to live through the cold of the Glacial period in some warm nook in Britain?" This he answered in the negative, except in the case of certain arctic and alpine species, which thus, he believes, form the oldest element of the British flora. Discussing (with the aid of specially prepared maps) the distribution of ice during the period of maximum intensity of cold, he concluded that the whole of the temperate flora must have been swept away as completely as the celebrated volcanic eruption of 1883 destroyed the vegetation of Krakatoa. Dealing now with the question of reimmigration, he could find no evidence for the existence of post-glacial land-bridges connecting the mainland of Great Britain with either the Scilly Isles, Ireland, or the Continent. Mr. Reid then mentioned some of the well-known peculiarities of distribution in our flora, especially the cases of the Pyrenean, Atlantic, and Germanic elements. Most of the species composing these elements are not really maritime plants, though they have a marked coastal distribution. This he explained as due to their comparatively recent introduction from the nearest continental shores, the lapse of time being such that the slow process of spreading inland has only as yet extended a few miles. Mr. Reid strongly urged the view that chance introduction of seeds (*e.g.* by birds driven by exceptionally strong gales) during thousands of years explains the existing peculiarities of geographical distribution in a way that no changes of sea or land or climate will do.

The president then read a letter which Mr. Reid had received from Dr. A. R. Wallace, F.R.S. Dr. Wallace said that he was firmly convinced that plants had great powers of distribution over the sea, in rare cases even for thousands of miles. Referring to the flora of the Azores, he said "there is absolutely no doubt that the whole of its plants have been gradually introduced during the latter half of the Tertiary period, over a width of ocean of about 1000 miles." But he could not accept Mr. Reid's view that the whole of our flora had been exterminated. "Temperature is only one of many, *very many*, factors that determine the distribution of species; and it is also certain that at the *southern limit* of the ice-sheet the winter temperature may have been quite mild enough to support a large number of our species." Dr. Wallace added that the covering of snow during the winter may have been a compensation for the low temperature.

Dr. Scharff discussed the problem from the zoological point of view, dealing principally with the larger mammals living in Ireland in present and past times. From the evidence of animal remains in the Irish turf, marl and cave deposits, Dr. Scharff maintained that many of the larger herbivores, *e.g.* Irish elk, reindeer, &c., survived in Ireland during the Glacial period. As these animals would require an abundant supply of vegetable food, he differed from Mr. Reid as regards the survival of both animals and plants in Ireland during the cold of the Glacial period.

Dr. O. Stapf, F.R.S., expressed his agreement with the opener's view as to the extinction and reimmigration of the temperate flora of the British Isles, but opposed the view that the curious distribution of the American, Atlantic, and limestone elements is due to chance introduction of seeds from great distances. He described the present distribution of the American and Atlantic plants in question, and pointed out that in both cases there existed (if the different species composing the two groups are considered) such gradations of discontinuity as to connect the extreme cases with cases of almost continuous areas. These extreme instances of discontinuous areas, then, would merely represent the last phase of disintegration. Dr. Stapf concluded by emphasising the importance of preserving and coordinating all records (of rare finds, &c.) which bear on the history of the flora of the British Isles.

Prof. C. Schröter dealt with the theories of Nathorst and Brockman with regard to the post-glacial history of the Swiss flora. He also pointed out that new evidence has accumulated showing the great importance of wind as a factor in the dispersal of plants in the Swiss Alps.

Mr. Wright directed attention to the presence of deeply submerged forests and peat-beds in the southern half of the British Isles. This indicates, though it scarcely proves, that a land connection with the Continent existed in post-glacial times. This connection seems to be demanded for the entry of the larger mammals which have found their way into England and Ireland since the Ice age. The evidence as to the total extinction of all life on Krakatoa has been questioned on the ground that seeds may have been preserved in the old surface deposits beneath the mantle of ash, and subsequently exposed for growth by the rapid formation of rain gullies known to have followed the eruption.

Prof. P. F. Kendall[1] entirely agreed with the conclusions of Mr. Reid, and instanced the case of the Isle of Man as indicating on a small scale what has probably happened in the British Isles as a whole. The Isle of Man presents a great variety of topographical, hydrographic, and other features, and thus offers conditions favourable to the maintenance of an equally varied flora and fauna. But the island is remarkably poor in the number of species of both animals and plants. The explanation seems clear that since the departure of the great ice-sheet the island has been repopulated by plants and animals introduced by chance agencies across the Irish Sea.

Dr. J. E. Marr, F.R.S.,[1] said it is generally admitted that after the great Ice age a period occurred which was marked by widespread steppe conditions. It is to be expected that survivals of this period would persist in areas not now under steppe conditions. He suggested that a case of such persistence may be found in a group of xerophytes growing on the Brecklands of North Suffolk and South Norfolk.

Prof. O. Drude pointed out that in attempting to solve a problem of this nature it was necessary to consider, not Great Britain alone, but also the whole of middle Europe. During what is known as the Baltic Ice age, *Picea excelsa*, and even Hymenophyllum, survived in Saxony. It is not impossible, therefore, that temperate forms, mingled with boreal, may have survived in the south of England.

Dr. F. J. Lewis was of opinion that the evidence of submerged peat deposits and buried forests pointed to considerably greater changes of level than those allowed by Mr. Reid. He also thought that the conditions of Krakatoa were so different from those of Britain during post-glacial times that comparisons between the two were unsafe.

Dr. C. H. Ostenfeld thought that the importance of "nunataks" has been overestimated. It is very difficult to be certain of whether a mountain summit has been glaciated or not. Dr. Ostenfeld maintained that the bulk of the temperate British flora had returned by means of a land-bridge, though he admitted that a few of the Atlantic and the two American species had probably arrived by chance.

Mr. E. A. N. Arber believed that land connections existed

[1] Prof. Kendall and Dr. Marr sent written communications, as they were unable to be present.

between England and France, both before and after the main period of glaciation.

Dr. C. E. Moss thought it a mistake to confine attention to the local "Lusitanian" species of west Ireland and south-west England. Belonging to the same distributional type are a number of halophytes, *e.g. Limonium reticulatum, Suaeda fruticosa*, &c., which in Britain are limited to the south and east coasts. These probably migrated from south Europe to Britain *via* the west coast of France. Being salt-marsh plants, their seeds are probably carried by ocean drifts. This may explain their absence from the west coast of Britain, as the trend of the currents is in an easterly direction.

Mr. G. Claridge Druce contributed to the discussion a statement of the appearance of species in isolated spots, *e.g. Scirpus maritimus* in Berkshire, and suggested that these were examples of chance dispersal by wind or birds. The same was probably true of the rapid spread of *Crepis taraxacifolia* over Midland England during the last twenty years.

Mr. Clement Reid briefly replied, and still adhered to his main contentions. With regard to the possible survival of plants in Britain, not only was the land itself glaciated, but the surrounding sea was intensely cold. On the subject of post-glacial connections with the Continent we cannot speak with absolute certainty, but he could find no evidence of sufficiently great oscillations of level to allow of their existence. The Irish peat-bog mammals referred to by Dr. Scharff are all good swimmers, and could quite well have crossed a narrow strait. This concluded one of the best discussions which has been held under the auspices of Section K.

The Principles of Constructing Phytogeographical Maps.

A second discussion was arranged for Tuesday morning, September 5, on the principles of constructing phytogeographical maps.

Dr. C. E. Moss, who opened this discussion, briefly traced the history of the recently issued British vegetation maps, and compared them with those produced on the Continent. Dr. Moss pointed out the uses, and also the limitations, of such maps. He emphasised the fact that vegetation maps are just as important as geological maps. Yet the latter are prepared and published by a Government department, while the former are left to the initiative of private individuals, who at present experience great difficulty in securing the publication of their work.

Prof. C. Schröter, who exhibited a fine collection of phytogeographical maps he had brought with him from Switzerland, classified such maps as follows:—(1) autochorological maps, which show the distribution of systematic units (genera, species, &c.); (2) synchorological or formation maps, illustrating the distribution of plant formations; (3) epiontological or historical maps, giving the distribution of floral elements and the history of their immigration; and (4) floristic maps, showing the division of a country into botanical regions.

Prof. O. Drude laid down certain important principles which should be observed in constructing phytogeographical maps. *E.g.* the colour scheme should be such as not to interfere with the general topography, which should be clearly distinguishable even in vegetation maps. Prof. Drude then proceeded to criticise the British maps in respect to certain technical details. He was followed by

Mr. A. G. Tansley, who pointed out that most of Prof. Drude's criticisms had been anticipated by the committee for the survey and study of British vegetation. Many improvements had been adopted in the later maps which, as Dr. Moss had pointed out, still awaited publication.

Dr. E. Rübel distributed copies of his vegetation map of the Bernina district in the Engadine. This map shows what can be done in the way of indicating on a single map such things as, *e.g.* in the case of woodland, not only the distribution of forest, but also the proportion of the more important trees, the types of undergrowth, &c.

Ecological Papers.

Thursday was largely devoted to individual ecological papers.

Prof. F. W. Oliver, F.R.S., read a paper on the life-history of a shingle bank, in which he dealt with the conditions under which plants exist on maritime shingle beaches. Most shingle banks are very mobile. This is due partly to the action of storm waves and partly to undermining by percolating sea water. A passive condition is indicated by the presence of lichens, &c. The origin of the soil occupying the interstices of the shingle was discussed. The most important source of this appears to be the drift on the lee side of the bank. This gradually becomes incorporated with the shingle during the slow landward march of the latter. Considered as a plant habitat, a very remarkable feature of a shingle bank is the rich supply of water with which it is provided, even in its upper zones. This feature requires further investigation.

Prof. C. Schröter next gave an illustrated account of the Swiss National Park and its flora. There are in Switzerland at the present time four organisations working for the preservation of natural and prehistoric monuments. One of the results of this movement has been the establishing of a National Park, or reservation. This is planned to cover an area of 200 square kilometres, about 90 of which have already been acquired.

Prof. J. Massart, in a very interesting paper on phytogeography as an experimental science, strongly urged the necessity for experiment as a method of attacking problems of plant geography. One example mentioned was the case of certain moorland plants (*e.g. Calluna vulgaris*) which flourish in such an unusual habitat as the limestone pavements of west Ireland. Why are these calcifuge species able to grow on limestone in Ireland? Is it because the climate is sufficiently favourable to enable them to withstand the deleterious effects of the calcareous soil? Or because the limestone forms of these species are biologic races, analogous to the cases of some parasitic fungi? Or is it that certain competing species are absent from Ireland? This and many similar problems can only be solved by direct experiment.

The afternoon session was opened by Prof. H. C. Cowles, who gave an illustrated account of a fifteen-year study of the advancing sand-dunes of Lake Michigan. These dunes are frequently 65 metres in height, and travel so rapidly that few of the antecedent plants are able to survive. Curiously enough, those which do so are not the more xerophytic species, but swamp plants and mesophytes, such as Cornus, Salix, Populus, &c. The survival of these plants depends on their capacity to elongate and produce new adventitious roots rapidly.

Miss S. M. Baker, in describing the brown seaweeds of a salt marsh, stated that all the brown seaweeds occurring near high-water level on rocky shores are capable of giving rise to marsh forms. Such marsh forms are frequently characterised by a spiral twisting of the thallus.

Prof. R. H. Yapp next discussed the causes which determine the formation of hairs and palisade cells in plants. The results of many previous experiments show that, in general, palisade tissue and the hairs on aërial shoots are best developed under external conditions which either favour transpiration or hinder absorption. The conclusion was arrived at that the initial stimulus leading to the development of these special cells is connected with a diminished water supply. But turgidity is a necessary condition for the actual growth of the cells. Thus periodic fluctuations in the turgor of the cells concerned, such as will frequently occur during the alternation of day and night, may play an important part.

Dr. F. J. Lewis read a paper on the forest stages represented in the peat underlying the moorlands of Britain. The author's earlier researches on this subject are well known. In this paper he gave some of the results of his more recent work in the Hebrides and elsewhere. The paper was well illustrated by lantern-slides.

A paper was communicated by Miss L. Baker and Mr. B. W. Baker on the plant associations of the district round Macclesfield.

Mr. W. B. Crump, in an interesting paper on the water-content of acidic peats, dealt with the question of the water supply of plants growing on acid soils. Mr. Crump emphasised the importance of considering the humus- as well as the water-content when analysing these soils. He contended that if the results of such analyses be expressed by the ratio water-content/humus-content some indication is obtained of the amount of water available for absorption by the plant.

A further communication by the same author described some experiments on the wilting of moorland plants, in which he attempted to determine directly the physiological water-content of moorland soils.

Palaeobotanical Papers.

Friday morning was chiefly occupied by the communication of palæobotanical papers.

Miss M. Kershaw described the structure and development of the ovule of a cycad, *Bowenia spectabilis*, dealing particularly with the complicated pollen-chamber of this genus. Miss Kershaw, and also several speakers in the discussion which followed, compared the ovule with certain fossil seeds, especially Trigonocarpon.

Dr. M. J. Benson read a paper on a new type of synangium, which she attributed to *Heterangium Grievii*. The author maintained that the discovery of this early synangium affords support to the synangial theory of the seed.

Dr. D. H. Scott, F.R.S., who followed, dealt with the structure and relationships of a rare Palæozoic fern, *Zygopteris Grayi*. This species possesses a five-rayed stellate stele, with internal xylem consisting of narrow tracheides embedded in parenchyma. Dr. Scott is inclined to regard this type of stele as an elaborated protostele rather than a condensation of a more complex vascular system.

Mr. H. Hamshaw Thomas gave a general account of recent researches on the Jurassic plants of Yorkshire. Amongst other things described were several new fossils found by Mr. Thomas himself, *e.g.* a new Bennettitalian "flower" with microsporophylls as well as ovules, and a fruit-like body containing seeds. To the latter he has given the name Caytonia. The discussion which followed centred mainly about the probable nature of this apparent fruit.

Prof. A. C. Seward, F.R.S., gave an account of the structure of a petrified Williamsonia collected by Hugh Millar in north-east Scotland, and figured by him in "The Testimony of the Rocks." The specimen, of which sections have been cut by permission of the director of the Royal Scottish Museum, Edinburgh, consists of a central conical axis bearing immature interseminal scales and seeds, the whole being enclosed by linear bracts bearing numerous unicellular hairs. The structure of the plant will be fully described in a forthcoming paper. In commenting on this paper in the discussion, Dr. Scott remarked that we know nothing at present about the young stages of the ovules in any Bennettitales.

From the examination of serial sections through entire boulders of calciferous sandstone from Pettycur, Miss T. Lockhart was led to results which confirm Dr. Gordon's view that petrifaction of the plant remains in these boulders occurred in thermal pools.

Cytological Papers, &c.

Cytological papers, &c., were taken on Friday afternoon. The first paper was one contributed by Dr. A. A. Lawson, on nuclear osmosis as a factor in mitosis. The results obtained by the author are at variance in several respects with those of previous observers. He finds that the nuclear membrane does not break down and disappear, but persists as a permeable plasmatic membrane. During mitosis, the nuclear sap diffuses through this membrane, which consequently closes in around the chromosomes, the nuclear cavity becoming much reduced. The author further maintains that the spindle threads are merely a drawing out of the cytoplasmic reticulum by the receding membrane. They thus represent lines of tension in the cytoplasm. They neither invade the nuclear cavity nor aid in drawing the daughter chromosomes to the poles of the spindle.

Dr. H. C. I. Fraser next gave a paper on the longitudinal fission of the meiotic chromosomes in *Vicia Faba*. This paper was a continuation of one communicated at the Sheffield meeting. The chromosomes undergo longitudinal fission during the telophase of the last archesporial division. The V-shaped chromosomes undergo a second longitudinal fission at the poles of the heterotype spindle. Both fissions are recognisable until the chromosomes pass on to the homotype spindle. The second fission disappears during metaphase, but is again visible when the chromosomes come into contact at the poles.

Mr. T. G. B. Osborn gave an account of the life-cycle and affinities of the Plasmodiophoraceæ. A cytological investigation of the life-history of *Spongospora subterranea* showed a very close similarity to that described for certain genera of the Plasmodiophoraceæ by Maire and Tison. The chief difference was that in Spongospora a fusion of nuclei in pairs occurred after the akaryote condition.

Mr. A. S. Horne followed with a paper on somatic nuclear division in *Spongospora Solani*, in which a peculiar form of karyokinesis was described as occurring during the early stages of the life-history.

The proceedings on Friday were terminated by a paper from Mr. A. E. Lechmere, on some West African fungi. Amongst others, a series of interesting forms were isolated which apparently belong to a new genus of Pyrenomycetes. Mr. Lechmere illustrated his paper by photographs and also living cultures.

The Semi-popular Lecture

The semi-popular lecture this year was given by Dr. Francis Darwin, F.R.S., the subject being "The Balance-sheet of a Plant." The lecture was exceedingly interesting and full of apt illustration, and was much appreciated by a crowded audience. Dr. Darwin explained that the "balance-sheet" of the title referred to the water supply of the plant. The lecture cannot be fully noticed here, but it may be mentioned that Dr. Darwin adduced some convincing experiments of his own to show that Lloyd's contention that transpiration is not regulated by movements of the stomata is contrary to fact.

Miscellaneous Papers.

Wednesday morning was occupied by a series of miscellaneous papers and reports of committees.

Mr. Mangham read a paper in which he gave the results of further work on the translocation of sugars by sieve-tubes. The investigation had been extended to Laminaria, and crystalline osazones were found in the cortical cells, sieve-tubes and hyphæ of two species of this genus, especially at the time of formation of the new lamina in *L. digitata*.

Prof. W. B. Bottomley dealt with the structure and functions of the root-nodules of *Myrica Gale*. He concluded that these nodules are concerned with the assimilation of atmospheric nitrogen, as are those of Cycas, Alnus, and other plants.

Another paper by the same author described some experiments on the effect of bacteriotoxins on the growth of plants. An aqueous extract of manure was found to have an injurious effect on the germination of seeds and on the subsequent growth of the seedlings. The harmful effect (which could be prevented by heating the extract) appeared to be due to bacteriotoxins, probably of the nature of toxalbumoses.

Mr. A. S. Horne suggested that the Cornaceæ are polyphyletic. This hypothesis is the result of a comparative study of the flower in the Cornaceæ and allied orders. The uniovular condition and other resemblances in the order are regarded merely as cases of parallelism, the evolutionary history being different in different cases.

Sir Daniel Morris, F.R.S., directed attention to the recent and rapid spread of *Oidium euonymi-japonicae* in southern England, and urged that steps should be taken to prevent the mischief caused by this pest.

Owing to the limited time available, and the absence of the authors, the following papers were taken as read:—the chromosomes of the hybrid *Primula kewensis*, by Miss L. Digby; and a note on the flora of Shetland, with some reference to its ecology, by Mr. W. West.

Reports of Committees.

Reports were presented by five research committees:—(1) The experimental study of heredity. The following summary of the report will indicate the scope of the work carried on. The experiments on the inheritance of double flowers have been continued. In the case of stocks, the results have now shown that this character is inherited in accordance with definite, though somewhat complicated, laws. Similar experiments have also been carried out on several other genera, chiefly biennials (carnation, hollyhock, &c.). These have now been carried to the third

generation. Investigations are being continued on the inheritance of a mutation in the foxglove. Investigations into the inheritance of colour in *Primula sinensis* have been carried further, and attention has been paid to the genetics of parti-coloured and flaked types. The inheritance of an abnormal type of flower in the wallflower is being investigated, and experiments are also being made with a putative hybrid between two species of Taraxacum. Mrs. Thoday has continued her experiments on the nature and inheritance of the yellow tinge in the sweet pea. (2) Botanical photographs. A second list of photographs collected by the committee has been printed and distributed to the botanical members of the association. By this means it is hoped that the collection will become more widely known, and used for teaching and other purposes. (3) A botanical, zoological, and geological survey of Clare Island. It is hoped that the survey will be completed by the end of the present year. (4) The structure of fossil plants. (5) On a national flora.

ANIMAL SANCTUARIES IN LABRADOR.[1]

A SANCTUARY may be defined as a place where man is passive and the rest of nature active. Until quite recently Nature had her own sanctuaries, where man either did not go at all or only as a tool-using animal in comparatively small numbers. But now, in this machinery age, there is no place left where man cannot go with overwhelming forces at his command. He can strangle to death all the nobler wild life in the world to-day. To-morrow he certainly will have done so unless he exercises due foresight and self-control in the meantime. There is not the slightest doubt that birds and mammals are now being killed off much faster than they can breed. And it is always the largest and noblest forms of life that suffer most. The whales and elephants, lions and eagles, go. The rats and flies, and all mean parasites, remain. This is inevitable in certain cases. But it is wanton killing off that I am now describing. Civilised man begins by destroying the very forms of wild life he learns to appreciate most when he becomes still more civilised. The obvious remedy is to begin conservation at an earlier stage, when it is easier and better in every way, by enforcing laws for close seasons, game preserves, the selective protection of certain species, and sanctuaries. The mere fact that man has to protect a sanctuary does away with his purely passive attitude. Then he can be beneficially active by destroying pests and parasites, like bot-flies or mosquitoes, and by finding antidotes for diseases like the epidemic which periodically kills off the rabbits, and thus starves many of the Carnivora to death. But, except in cases where experiment has proved his intervention to be beneficial, the less he upsets the balance of nature the better, even when he tries to be an earthly Providence.

The strongest of all arguments is that sanctuaries, far from conflicting with other interests, actually further them. But unless we make these sanctuaries soon we shall be infamous for ever as the one generation which defrauded posterity of all the preservable wild life that nature took a million years to evolve into its present beautiful perfection. Only a certain amount of animal life can exist in a certain area. The surplus must go outside. So sanctuaries are more than wild "zoos"; they are overflowing reservoirs, fed by their own springs, and feeding streams of life at every outlet. I might mention many instances of successful sanctuaries, permanent or temporary, absolute or modified—the Algonquin, Rocky Mountains, Yoho, Glacier, Jasper and Laurentides in Canada; the Yellowstone, Yosemite, Grand Cañon, Olympus, and Superior in the United States; with the sea-lions of California, the wonderful revival of ibex in Spain and deer in Maine and New Brunswick, the great preserves in Uganda, India, and Ceylon, the selective work of Baron von Berlepsch in Germany, the curious result of taboo protection up the Nelson River, and the effects on seafowl in cases so far apart in time and space as the Guano Islands under the Incas of Peru, Gardiner Island in the United States, or the Bass Rock off the coast of Scotland.

Yet I do not ignore the difficulties. First, there is the universal difficulty of introducing or enforcing laws where there have been no operative laws before. Next, there is the difficulty of arousing public opinion on any subject, however worthy, which requires both insight and foresight. Then we must remember that protected species increasing beyond their special means of subsistence have to seek other kinds of food, sometimes with unfortunate results. And then there are the several special difficulties connected with Labrador.

But in spite of all difficulties, I firmly believe that Labrador is by far the best country in the world for the best kinds of sanctuary. Labrador decidedly improves on acquaintance. The fogs have been grossly exaggerated. The Atlantic seaboard is clearer than the British Isles, which, by the way, lie in exactly the same latitudes. And the Gulf is far clearer than New Brunswick, Nova Scotia, and the Banks. The climate is exceptionally healthy, the air a most invigorating tonic, and the cold no greater than in many a civilised northern land. Besides, there is a considerable range of temperature in a country the extreme north and south of which lie 1000 miles apart, one in the latitude of Greenland, the other in that of Paris.

Most of Labrador is a rocky tableland, still rising from the depths, with some old beaches as much as 1500 feet above the present level of the sea. The St. Lawrence seaboard is famous for its rivers and forests. The Atlantic seaboard has the same myriads of islands, is magnificently bold, is pierced by fiords unexcelled in Norway, and crowned by mountains higher than any others east of the Rockies. This vast country is accessible by sea on three sides, and will soon be accessible by land on the fourth. It lies directly half-way between Great Britain and our own North West, and is 1000 miles nearer London than New York is. Its timber, mines, and water-power will be increasingly exploited. It should also become increasingly attractive to the best type of tourist, naturalist, and sportsman.

The fauna is much more richly varied than people who think of Labrador as nothing but an Arctic barren are inclined to suppose. The fisheries have been known for centuries, especially the cod, which has a prerogative right to the simple word "fish." There are herring and lobsters in the Gulf, plenty of salmon and trout in most of the rivers, winninish in all the tributary waters of the Hamilton, as well as in Lake St. John, whitefish in the lakes, and so forth. Then the stone-carrying chub is one of the most interesting creatures in the world.

Yet I must not forget the "flies"—who that has felt them once can ever forget them? The bot-fly infests the caribou, and will probably infest the reindeer. The black-fly and mosquito attack both man and beast in maddening millions.

Labrador has more than 200 species of birds, from humming-birds and sanderlings to eagles, gannets, loons, and herons.

Both the land and sea mammals are of great importance. Several whales are well known. The right whale is almost exterminated, but the Greenland, or bow-head, is found along the edge of the ice in all Hudsonian waters. The pollock is rare, and the sperm, or cachalot, as nearly exterminated as the right. But the little-piked, or *rostrata*, is found inshore along the north and east, the bottle-nose on the north, the humpback on the east and south, and the finback and sulphur-bottom are common and widely distributed, especially on the east. The little white whale, or "white porpoise," is fairly common all round; the killer is widely distributed, but most numerous on the east, where the narwhal is also found. The harbour and striped porpoises, and the common and bottle-nosed dolphins, are chiefly on the east and south. There are six seals, the harbour, ringed, harp, bearded, grey, and hooded. The walrus, formerly abundant all round, is now rarely seen except in the far north, where he is fast decreasing.

Moose may feel their way in by the south-west to an increasing extent, and might possibly be reinforced by the

[1] From an address presented by Lieut.-Colonel William Wood before the second annual meeting of the Commission on Conservation held at Quebec.

Alaskan variety. Red deer might possibly be induced to enter by the same way in fair numbers over a limited area. The woodland caribou is almost exterminated, but might be resuscitated. The barren-ground caribou is still plentiful in the north. Their tame brother, the reindeer, is being introduced as the chief domestic animal of eastern Labrador, with apparently every prospect of success. Beaver are fairly common and widely distributed in forested areas. Other rodents are frequent—squirrels, musk-rats, mice, voles, lemmings, hares, and porcupines. There are two bats. Black bears are general; polars in the north. Grizzlies have been traded at Fort Chimo in Ungava, but they are probably all killed out. The lynx is common wherever there are woods. There are two wolves, arctic and timber, the latter now rare in the south. The Labrador red fox is very common in the woods, and the "white," or arctic fox, in the barrens and further south on both coasts. The "cross," "silver," and "black" variations of course occur, as they naturally increase towards the northern limits of range. The "blue" is a seasonal change of the "white." The wolverine and otter are common. The skunk is only known in the south-west. The mink ranges through the southern third of the peninsula. The Labrador marten, or "sable," is a subspecies, generally distributed in the forested parts, like the weasel. The "fisher," or Pennant's marten, is much more local, ranging only between the "North Shore" and Mistassini.

When we consider how easily wild life can be preserved in Labrador, and how beneficial its preservation is to all concerned, we can understand how the wanton destruction going on there is quite as idiotic as it is wrong.

Take "egging" as an example. The Indians, Eskimos, and other beasts of prey merely preserved the balance of nature by the toll they used to take. No beast of prey, not even the white man, will destroy his own stock supply of food. But with the nineteenth century came the white-man market "eggers," systematically taking or destroying every egg in every place they visited. Halifax, Quebec, and other towns were centres of the trade. The "eggers" increased in numbers and thoroughness until the eggs decreased in the more accessible spots below paying quantities. But other egging still goes on unchecked. And this is on the St. Lawrence, where there are laws and wardens and fewer fishermen. What about the Atlantic Labrador, where there are no laws, no wardens, many more fishermen, and ruthless competitive egging between the residents and visitors? Of course, where people must egg or starve there is nothing more to be said.

And it is just as bad with the birds as with the eggs. A schooner captain says. "Now, boys, here's your butcher shop: help yourselves!" and this, remember, is in the brooding season. Not long ago the men from a vessel in Cross Harbour landed on an islet full of eiders, and killed every single brooding mother. In the summer of 1907 an American millionaire's yacht landed a party who shot as many brooding birds on St. Mary Island as they chose, and then left the bodies to rot and the broods to perish. That was, presumably, for sport. Deer were literally hacked to pieces by construction gangs on new lines last summer. Dynamiting a stream is quite a common trick wherever it is safe to play it. Harbour seals are wantonly shot in deep fresh water where they cannot be recovered, much as seagulls are shot by blackguards from an ocean liner.

And the worst of it is that all this wanton destruction is not by any means confined to the ignorant or those who have been brought up to it.

We have had our warnings. The great auk and the Labrador duck have both become utterly extinct within living memory. The Eskimo curlew is decreasing to the danger point, and the yellowlegs is following. The lobster fishing is being wastefully conducted along the St. Lawrence; so, indeed, are the other fisheries. Whales are diminishing. The walrus is exterminated everywhere in Labrador except in the north. The seals are diminishing. The woodland caribou has been killed off to such an extent as to cause both Indians and wolves to die off with him. The barren-ground caribou is still plentiful, though decreasing.

All the sound reasons ever given for conserving other natural resources apply to the conservation of wild life—and with threefold power. When wild life is squandered it does not go elsewhere, like squandered money; it cannot possibly be replaced by any substitute, as some inorganic resources are: it is simply an absolute dead loss, gone beyond even the hope of recall. How is Labrador to be brought under conservation, before it is too late, in the best interests of the five chief classes of people who are concerned already, or will be soon? The five great interests are those of (1) food; (2) business; (3) the Indians and Eskimos; (4) sport; and (5) the zoophilists, by which I mean all people interested in wild animal life, from zoologists to tourists.

The resident population is so sparse that there is not one person for every 20,000 acres; and most of these people live on the coast. Consequently, the vast interior could not be used for food supplies in any case.

Business is done in fish, whales, seals, fur, game, plumage, and eggs. The fish are a problem apart. But it is worth noting that uncontrolled exploitation is beginning to affect even the countless numbers in certain places. No one wants his business to be destroyed. But if Labrador is left without control indefinitely every business dealing with the products of wild life will be obliged to play the suicidal game of competitive grab until the last source of supply is exhausted, and capital, income, and employment all go together.

The Eskimos are few, and mostly localised. The Indians stand to gain by anything that will keep the fur trade in full vigour, as they are mostly hunters and trappers. Restriction on the number of skins, if that should prove necessary, and certainly on the sale of all poisons, could be made operative.

Sport should have a great future in Labrador. The extension and enforcement of proper game laws would benefit sport directly, while indirectly benefiting all the other interests.

The zoophilist class seems only in place as an afterthought. But I am convinced that it will soon become of at least equal importance with any other. All the people, from zoologists to tourists, who are drawn to such places by the attraction of seeing animal life in its own surroundings already form an immense class in every community; and it is a rapidly increasing class.

Partly because Quebec has taken the lead in legislation, and partly because an ideal site is ready to hand under its jurisdiction, I would venture to suggest the immediate establishment of an absolute sanctuary for all wild birds and mammals along so much of the coast as possible on either side of Cape Whittle. The best place of all to keep is from Cape Whittle eastward to Cape Mekattina, sixty-four miles in a straight line by sea. Cape Whittle is a great landmark for coasting vessels and for the seal herds as well. A refuge for seals is absolutely necessary to preserve their numbers and the business connected with them. The case of the birds is quite as strong, and the chance of protection by this sanctuary much greater.

There is the further question—affecting all migratory animals, but especially birds—of making international agreements for their protection. There are precedents for this, both in the Old World and in the New: and, so far as the United States is concerned, there should be no great difficulty. Immediate steps should be taken to link our own bird sanctuaries with the splendid American chain of them which runs round the Gulf of Mexico and up the Atlantic coast to within easy reach of the boundary line. Corresponding international chains up the Mississippi and along the Pacific would be of immense benefit to all species, and more particularly to those unfortunate ones which are forced to migrate down along the shore and back by the middle of the continent, thus running the deadly gauntlet both by land and sea.

Inland sanctuaries are more difficult to choose and manage. A deer sanctuary might answer near James Bay. Fur sanctuaries must also be in some fairly accessible places on the seaward sides of the various heights-of-land, and not too far in. The evergreen stretches of the Eastmain River have several favourable spots. What is needed most is an immediate examination by a trained zoologist. The existing information should be brought together and carefully digested for him in advance.

THE PRESENT POSITION OF ELECTRIC STEEL-MELTING.[1]

THE melting of steel by means of electricity has passed the merely experimental stage and become one of the commercial processes by means of which steel is manufactured for the market. It is not correct to say that it has emerged from the experimental stage, however, as not only this process of steel-making, but most other processes, are being continually experimented with and the results compared with one another by up-to-date and vigorous firms, not only for the new conditions that are always arising, but also for old and well-tried conditions.

A new demand arises or repeat orders come in, and the manufacturer must ask himself what kind of steel will best suit the purpose at the present time. Will Bessemer or open-hearth steel be most suitable to satisfy the demand, price, quality, and all other matters considered, and must it be acid steel or will basic do, or is it necessary or desirable to use crucible steel, or perhaps this new electric steel, to maintain or increase his profit or his reputation for certain goods? These are problems of daily occurrence; and although the difficulties of the manufacture of electric steel by various processes have been fairly well overcome, so far as making it to specification of chemical composition and mechanical tests is concerned, it is in connection with such questions as are indicated in the previous sentence that it is still in the earlier experimental stage. All other processes, however, are more or less under such trials until they become extinct. The point need not be laboured, for many examples will come to the mind at once, such as the comparative merits for various purposes of Swedish-Lancashire and Walloon iron, of mild steel and wrought iron, of acid and basic steel, and so on. The general impression gathered from much conversation with users is that the arc-furnace product from slightly impure materials, purified to Swedish standard, just about takes its place by Swedish open-hearth and Bessemer steels, and that the induction-furnace product skilfully made from pure materials equals anything but the very highest qualities of crucible steels. These are very general statements, but they represent the writer's present more or less intuitive opinions, and only time can determine whether they are correct; for the fact that steels are of certain chemical compositions and give certain mechanical tests is not a final judgment, but the quality and length of service given in actual use. The special feature of the Héroult and Röchling-Rodenhauser types is that with an oxidising purification phosphorus can be eliminated to almost any extent that will pay, and after removing the slag, and forming another, by a reducing purification sulphur can similarly be removed.

The Kjellin induction furnace acts as a melter of materials much after the manner of the crucible, and has one advantage over the crucible in that there is no absorption of sulphur during melting. Recent experiments with covering slags specially calculated by the writer to give a minimum of change in composition during melting show, according to a student's preliminary analysis, compositions in the ingots practically equal to those by calculation from the constituents, a result better than expected, but still requiring thorough checking. The results at least serve as a text for one fact that must never be forgotten. The electric furnace, of whatever design, will not make good steel automatically. The same metallurgical skill required by the older processes must be expended on the proper killing and finishing of the steel by whatever type of electric furnace it is being melted, and the fact that in electric as in other furnaces bad steel may be made from good materials increases the difficulties of finding the exact place of any steel in the world's work. Several cases where the electric steel has been found unsuitable, especially in the earlier days, have been investigated, and it has been found that the steel has been wrongly made. In other cases no such explanation could be given. Recently I had a long talk with a man using large quantities of electric steel; he could get great purity, but no better mechanical tests; yet he found the electric steel gave a better life than his former steel, and so he used it. Here again another difficulty comes in as represented by the fact that I did not think his ordinary steel was specially well made.

[1] Report presented at the Portsmouth meeting of the British Association (Section B) by Prof. Andrew McWilliam.

One point of importance is that this production of electric steel has introduced a new competitor into the field by giving great impetus to the use of what is sometimes called white coal, namely, the great waterfalls, mostly far removed from coal; and much energy is now being used that formerly ran to waste, whilst the successful application of electric power to the production of charcoal pig-iron allows of a much reduced consumption of charcoal. The rapidly increasing price of charcoal in Sweden, owing, among other causes, to so much of the wood being used for making wood pulp for paper-making, is quite a serious situation, which this application of electric power may help to relieve.

The whole subject of electric iron-smelting and electric steel-melting is attracting much attention. Several books have been published on electric furnaces; and during 1909 and 1910 many interesting articles on the subject have appeared in the technical journals, and many papers have been read before the Iron and Steel Institute. At the autumn meeting of 1909 Mr. C. A. Ljungberg gave a paper on production of iron and steel by electric-smelting processes. He mentioned the Kjellin electric induction furnace at Gysinge, with which the writer had the pleasure of making with Mr. E. C. Ibbotson a full week's trial, as being still in work, making tool steel, special steels, self-hardening and high-speed steels, and others such as nickel and chromium steels. The paper dealt more in detail, however, with the successful experiments on smelting pig-iron at Domnarfvet by electrical means, and the resulting saving in the proportion of charcoal used.

It will be only necessary merely to touch upon the various principles used in the construction of electric furnaces, as these are found in text-books and in the Proceedings of the Iron and Steel Institute. Having obtained an electric current, its energy may be converted into heat by putting a suitable resistance in its path, and the heat may be concentrated at any part of the circuit by making the resistance of other parts small in comparison. If the resistance be a solid or a liquid, then it is called resistance-heating; if a gas, arc-heating. If the liquid through which the current passes is decomposed by the current so that one kind of matter goes to one pole and another kind to the other pole, the liquid is called an electrolyte.

Varieties of Electric Furnaces.

The Stassano furnace is an independent arc furnace. Three carbon electrodes are used, between which arcs play, and the heat from the arc is merely used for heating the charge, partly by direct radiation and partly by reflection from the dome of the furnace.

The Héroult steel-melting furnace is a direct-arc type in which the charge forms one pole of the arc. Two vertical carbon electrodes come through the roof of the furnace and two arcs play, one between each electrode and the molten metal or slag beneath it, the current passing from one electrode through the metal or slag and up through the other electrode.

The Girod furnace, like the Héroult, is a direct-arc furnace, but one or more electrodes of like polarity are maintained above the bath, and soft steel pieces embedded in the hearth of the furnace are in direct contact with the molten metal for the negative electrode. These lower pole-pieces are water-cooled. Large quantities of ferro-silicon, ferro-chrome, &c., as well as of ordinary carbon and special steels, are made in this furnace.

The Keller steel furnace is a direct-arc furnace, very much like the Héroult, only instead of two electrodes coming down into one cavity they come into separate cavities, which are joined by the molten material of the bath.

The Grönwall is of the arc type, and the current enters by two electrodes through the roof; and when once the bath is heated, so that the lining becomes a conductor, the current from both electrodes passes through the lining to a graphite block underneath, and hence to a common wire.

The Nathusius, like the Grönwall, is a combined arc and resistance furnace. It contains three vertical carbon electrodes, arranged at the apices of an equilateral triangle,

and three steel electrodes similarly arranged in the bottom of the furnace, but covered by refractory material. Three-phase current is used, and it is claimed that the current flows from one top electrode to the others, from one bottom electrode to the others, and from each top electrode to each bottom electrode.

Kjellin Induction Furnace.—In this furnace, an example of which is in the metallurgical laboratory of the University of Sheffield, and was shown working to the members of the British Association, the metal charge is placed in an annular hearth, almost like a steel-melting crucible in section, but in the form of a ring. The primary coil of twenty-four turns is placed in the centre round a core of laminated iron. The bath or ring of metal acts as a secondary circuit of a single turn, and the heat is thus produced in the charge itself without contact with electrodes. In the Frick furnace the primary coil is above the crucible, and in the Colby round the outside of the crucible.

The Röchling-Rodenhauser furnace is based on the Kjellin principle, but has an important addition. In its simplest form, for single-phase current, there are two grooves, or heating channels, corresponding to the annular crucible of the Kjellin, but these join to a central open-hearth, the whole hearth forming a kind of figure 8. In the central open-hearth all the distinctly metallurgical operations take place, so that this form can be used for refining work, for which the Kjellin is not very suitable. Not only so, but a distinct secondary winding is provided in which a secondary current is induced, and these windings are joined to steel terminal plates which are embedded in the refractory material of the furnace at the ends of the central hearth. At high temperatures the refractory material becomes a conductor of electricity, and thus the currents induced pass through the bath in the central hearth, heating it still further.

There are many others, some only on paper; but these are the principal varieties that have been tried with any considerable degree of success. The loss in melting is an important point, and I am informed that this amounts to about $1\frac{1}{2}$ per cent. in the Kjellin, about 4 to 5 per cent. in the Röchling-Rodenhauser, and 7 to 8 per cent. in arc furnaces.

In considering the present position of the electric steel-melting industry regard must be had to the numbers and capacities of the various types of furnaces in work, not in work, and being built, although a complete survey should also take account of the nature and quality of the materials being made, for a furnace making a ton of high-speed steel should obviously be credited with more importance in the commercial world than one making a ton of steel for rails. The progress in numbers and capacities and in output should also be considered. So far as one could ascertain, about June, 1910, there were about 118 furnaces of all types, of which 70 were in use, 10 not working, and 38 being built. There were 77 of the arc furnaces recorded, of which 29 were credited as Héroult, 17 Girod, 13 Stassano, 6 Keller, and 9 others; besides one furnace at Domnarfvet, Sweden, for the production of 2500 tons of pig-iron per annum, with one in Norway and one at Trollhättan, Sweden, both in course of construction, and each designed to produce about 7500 tons of pig-iron annually. Of the Héroult furnaces, the total capacity per charge of those working was about 80 tons, and of those in course of construction about 50 tons. The Girod furnaces, the great competitors of the Héroult, were recorded at about 38 tons in work and 26 tons being built. Similarly, the figures for the Keller were 13 tons and 5 tons, and for the others 20 tons and 13 tons respectively.

Of the induction furnaces, the Kjellin furnaces erected totalled fourteen, with 35 tons capacity; the Röchling-Rodenhauser fifteen, with 30 tons in work, 1 ton not in work, and 17 tons capacity being built; all others about 18 tons in work. That gave a total capacity of about 250 tons for the arc furnaces and 100 tons for the induction, or a grand total of 350 tons per charge for all electric steel-melting furnaces. Pressure of other work has prevented me from getting the latest figures from all the firms making electric furnaces, but I have obtained these from the two most important firms, viz. the Héroult and the Kjellin and Röchling-Rodenhauser, and in this connection would record my best thanks to Mr. Donald F. Campbell and Mr. E. C. Ibbotson, respectively, for their kind help and trouble in getting me this information. Comparing the Héroult furnaces only, as an example, we have seen that in June, 1910, there were twenty-nine of these furnaces with a capacity of 80 tons in work and 50 tons in course of erection, 130 tons in all; whilst about June, 1911, there were forty-three furnaces, with a total capacity of about 242 tons

The output of electric steel in Germany, the United States, and Austria-Hungary in 1910 amounted to almost 112,000 tons, which is an increase of 63,000 tons over the figures for 1909. These are the only countries for which the exact output of electric steel is published, but there is no doubt that the figures for Sweden, France, Belgium, and Italy would also show large gains. The increase will probably be more than maintained in 1911, as more than thirty new furnaces of various types should be started during the year, and many which only started towards the end of 1910 will put in a full year's work in 1911. England will also for the first time appear as a regular producer. Before the beginning of the present year the Héroult furnace at Edgar Allen's in Sheffield was the only arc one in steady operation. In January three Héroult furnaces were commenced in England: at Vickers' and Thos. Firth and Sons' in Sheffield, and at Lake and Elliott's in Braintree, Essex. A Grönwall furnace, for demonstration and manufacturing purposes, also started at about the same time in Sheffield; and the output of England for 1911 should amount to about 13,000 tons. A 15-ton Héroult furnace is to be erected at Skinningrove shortly, and is expected to turn out 200 tons per day. About the same period Kjellin induction furnaces have been working satisfactorily at Vickers and Jessop's in Sheffield and an experimental furnace at the University of Sheffield.

Great progress will be made in Germany with electric furnaces during the next year, when Héroult furnaces of 25 and 22 tons capacity are to be constructed. At present the largest size are the two 15-ton Héroult furnaces at S. Chicago and Worcester, belonging to the United States Steel Corporation, who have recently acquired the Héroult patents for America, and will probably erect several more furnaces shortly.

The electric furnace can be used either for melting scrap directly or in combination with some other form of furnace, in which case it simply acts as a refiner. The majority of the recent furnaces have been employed in this way, in conjunction either with Bessemer or open-hearth furnaces. The latter are usually of the basic tilting type, part of the charge being removed to the electric furnace after the pig is melted and the bulk of the phosphorus removed, leaving some phosphorus and the oxygen and sulphur to be eliminated by the electric furnace. In this case the time required for the electric furnace is from one hour to two hours, according to the degree of refining required and the original condition of the steel when removed from the basic furnace. The power used varies from 100 to 300 kw. hours per ton. When cold scrap is melted the time required is about six hours, and the power consumption said to be from 650 to 750 kw. hours; but really, all in, more probably 800 to 1000 per ton. Of the forty-four Héroult furnaces in operation or construction twenty-one are to melt scrap, twenty to take molten steel from the basic open-hearth, one from a Talbot furnace, and two from converters.

Electric furnaces are being employed in the following cases:—

(1) To replace crucibles. The gain is then one of cost of production.

(2) For foundries. Electric furnaces are being used in many foundries. At Georg Fischer's and Schaffhausen they are the only furnaces employed, and Lake and Elliott, of Braintree, are now making most of their steel electrically.

(3) To replace Swedish Bessemer steel, and for steel of axle and tyre quality.

(4) For weldless tubes. The Mannesmann Company has Héroult furnaces in Germany and Italy.

(5) In combination with Talbot furnaces. Owing to the fact that the heat need not be sufficiently great for teeming on transference to the electric furnace, the output of the Talbot and the life of the lining and roof are said

to be largely increased. This will be the procedure at Skinningrove for making rails.

(6) For melting turnings, especially high-speed turnings. These make excellent scrap for the electric furnace. Nickel scrap can be melted without any loss of nickel.

There are two aspects of the present position of a comparatively new industry. One is the progress made during the year, and an endeavour has been made to present that point of view. Another aspect is the actual state of the industry at present, and that can best be judged by the following two tables representing the furnaces, capacities, and kind of work done by all the furnaces under the care of the two principal firms already named. A very interesting item in the induction-furnace list is the entry representing the fact that the Kjellin furnace has been adopted for melting the metal for the manufacture of those delightful, though expensive, culinary vessels of pure nickel so much appreciated now.

List of Héroult Furnaces in Construction or Operation.

Country	Firm	Size of Furnace	Method of Melting
		Tons	
England	Edgar Allen and Co., Ltd., Sheffield	2½	Tilting basic open-hearth
	Skinningrove Iron Co., Yorkshire	15	Talbot
	Vickers, Ltd., Sheffield ...	3	Melting scrap in electric furnace
	Thos. Firth & Sons, Ltd., Sheffield.	2½	" "
	Lake and Elliott, Braintree ..	2½	" "
Austria	Kaernthner Eisen & Stahl Werke	5	" "
	Gebr. Böhler & Cie. A.G., Kapfenberg	2½, 4	" "
	Brüder Lapp, Rottenmann, Works, Steiermark	6	" "
	Danner & Co., Judenberg ...	2	" "
Belgium	Société des Usines Métallurgiques du Hainaut, Coultret	5	Basic open-hearth
	Société Anonyme Ougrée-Marihayé, near Liège	5	" "
France	Société Electro-Métallurgique Française, La Praz, Savoie ...	2½	Melting scrap in electric furnace
	Aciéries du Saut du Tarn, St. Juèry	5	" "
	Usine Métallurgique de la Basse Loire, Trignac... ...	5	Basic open-hearth
Germany	Works of August Thyssen :—		
	Deutscher Kaiser Stahlwerke, Bruckhausen	7	" "
	Deutscher Kaiser Stahlwerke, Mülheim	6	" "
	Deutscher Kaiser Stahlwerke, Bruckhausen	25	" "
	Stahlwerke Richard Lindenberg, Remscheid-Hasten ...	2, 3	Tilting basic open-hearth
	Bismarckhütte, Upper Silesia...	1, 3	Melting scrap in electric furnace
	Mannesmann Röhren Werke, Saarbrücken, Burbach ..	3	Open-hearth
	Rombacher Hüttenwerke, Rombach	22, 3	" "
	Deutsch Luxemburgische, Dortmund	7, 7	" "
Italy	Società Tubi Mannesmann, Dalmine	6, 6	Melting scrap in electric furnace
Russia	Imperial Steel Works, Obuchow, St. Petersburg	3½	Open-hearth
	Aktiengesellschaft der Hütten und mechanischen Werke, Ssormovo	3	" "
	Société Générale des Hts. Fourneaux & Aciéries en Russie, Makejawka	3	" "
Sweden	Aktiebolaget Héroults Elektriska Stal, Kortfors	6	Melting scrap in electric furnace
Switzerland	Georg Fischer, Schaffhausen ...	1½	" "
Canada	Electro Metals, Welland ...	½, 5	" "
United States	United States Steel Corporation, S. Chicago	15	Bessemer
	United States Steel Corporation, Worcester	15	Basic open-hearth
	Firth-Stirling Co., Syracuse, New York	2½, 5	Melting scrap in electric furnace
	Halcomb Steel Co., Syracuse, New York	5	Tilting basic open-hearth
	Crucible Steel Co. of America, Pittsburg, Pa.	5	Basic open-hearth
Mexico	Cie. Mexicano Aciero & Productos Chemicos	4	Melting scrap in electric furnace
	43 Furnaces	242½	

List of Kjellin and Röchling-Rodenhauser Furnaces now in Operation or in Erection.

Type	No.	Country	Firm	In Operation	Not in Operation	In Erection	Kind of Current	Kw.	Notes
				Charge Kg.					
Kjellin	1	GERMANY	Fr. Krupp, A.-G., Essen a.R.	8500	—	—	Single phase	750	
	2		Oberschlesische Eisen-ind. A.-G., Gleiwitz	1500	—	—	" "	180	
Röchling-Rodenhauser	3		Röchling'sche Eisen- & Stahlwerke Volklingen ...	7000	—	—	" "	750	
	4			2000	—	—	Three phase	275	
	5			—	—	2000	" "	275	
	6			—	—	2000	" "	275	
	7		Pilgar und Neidhardt, Frankfurt a.M.	—	—	2000	Single phase	275	
	8		Bergische Stahlindustrie Remscheid	5000	—	—	" "	500	
Röchling-Rodenhauser	9	LUXEMBURG	Le Gallais, Metz & Co., Domneldingen	3500	—	—	" "	380	
	10			3500	—	—	" "	380	
	11			700	—	—	" "	100	
	12			1500	—	—	Three phase	275	
	13			3500	—	—	Single phase	380	
Kjellin	14	AUSTRIA	Poldihütte, Kladno	4000	—	—	" "	440	
	15		J. Braun's Söhne, Vocklabruck...	400	—	—	" "	65	In operation when water available.
Röchling-Rodenhauser	16	FRANCE	Aciéries de la Marine et d'Homecourt, St. Chamond.	—	—	3000	Three phase	350	
Kjellin	17	GREAT BRITAIN	Vickers, Sons & Maxim, Sheffield	—	1500	—	Single phase	230	Not in operation at present moment.
	18			—	—	180	" "	100	
	19		W. Jessop & Sons, Sheffield	—	—	1800	" "	250	
	20		The University of Sheffield	100	—	—	" "	60	Experimenting Furnace.
Röchling-Rodenhauser	21	BELGIUM	Aciéries Liégeoises, Pressoux-les-Liége	—	1000	—	Three phase	200	Firm in Liquidation.
Kjellin	22	ITALY	Alti Forni Gregorini, Lovere	—	—	1500	Single phase	330	
Kjellin	23	SPAIN	Vidua de Urigeitia é Hija, Araya	1500	—	—	" "	215	In intermittent operation.
Kjellin	24	SWEDEN	Domnarfvets Jernverk (Gysinge)	1500	—	—	" "	175	
	25		Sybry Searls, Ltd., Trollhättan...	2000	—	—	" "	300	In operation when water available.
Röchling-Rodenhauser	26	RUSSIA	Kronwerke Slataoust	—	—	1000	Three phase	175	
Kjellin	27	U.S.A	American Electric Furnace Co., Niagara Falls ...	750	—	—	Single phase	150	
Colby	28			100	—	—	" "	60	
Kjellin	29		General Electric Co., Schenectady	60	—	—	" "	50	
Röchling-Rodenhauser	30	MEXICO	Ricardo Honey, Mexico	—	—	2500	Three phase	300	

Besides: 1 Furnace at the Berndorfer Metallwarenfabrik, A. Krupp, Berndorf, for treatment of nickel and nickel alloys.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Recent appointments include:—Mr. J. E. Coates, special lecturer in physical chemistry, to succeed Prof. Alex. Findlay; Dr. E. P. Frankland, Mr. P. May, and Mr. Ernest Vanstone assistant lecturers and demonstrators in chemistry; Dr. Thomas Yates, special lecturer in osteology; Dr. J. R. Heath, lecturer in physiology.

The council of the University has decided to increase from 25*l.* to 100*l.* the annual grant to the Workers' Educational Association, which provides classes for working men and women.

PROF. G. E. HALE is prepared to receive applications for the post of assistant in the department of stellar spectroscopy at the Mount Wilson Solar Observatory. Practical experience of observatory work is desirable, and a knowledge of physical optics and spectroscopy is essential.

THE *London University Gazette* announces that a bequest has been made to "the governors for the time being of University College" by the late Mr. A. R. T. Momber of certain shares of his estate. Under the benefaction a sum of 7000*l.* will eventually accrue to the University.

IT is stated in *Science* that President W. H. P. Faunce has announced that 80,000*l.* of the endowment fund of 200,000*l.* which Brown University is endeavouring to secure has already been subscribed. The General Education Board has contributed 30,000*l.*, and eight gifts of 5000*l.*, together with smaller amounts aggregating 10,000*l.*, have been received. From the same source we find that Mr. Charles Scribner has given to Princeton University a completely equipped printing plant, provided at a cost of 25,000*l.*

AN appeal for funds towards the establishment of a modern university in Central China at Hankau-Wuchang has just been made. The scheme is promoted by committees representative of the Universities of Oxford, Cambridge, and London in this country, and of the Universities of Harvard, Columbia, California, and Toronto in Canada and the United States of America. During the three years which have elapsed since its inception the committee has been engaged in settling the lines upon which the University is to be founded, in locating the most advantageous site, in appointing the first president (Mr. W. E. Soothill, late principal of the Imperial University of Shansi), and in other essential preliminaries. An appeal is made for a capital sum of 250,000*l.* for the foundation of the University, the purchase of a site, the erection and equipment of buildings, and the endowment of professorships. It is hoped that one half of this sum, 125,000*l.*, will be the British contribution towards the project, and that the other half will be contributed by America. The general basis of the University will be that of a teaching and examining body working in cooperation with a number of self-governing residential colleges and hostels. The foundation of a university for Central China is desirable on the ground that in this way Great Britain and America can render to China at the present stage a service of incalculable importance and of far-reaching consequence. A seat of learning will thus be established in China which will be inspired by the best traditions of the cooperating Western universities. Donations can be sent to the Most Hon. the Marquess of Salisbury, G.C.V.O., 20 Arlington Street, London, W., or to the honorary treasurer, University for China, 22 Albemarle Street, London, W. Cheques should be drawn in favour of the "University for China." Further particulars can be obtained from the secretary, 22 Albemarle Street, London, W.

THE Education Committee of the London County Council at a recent meeting came to certain important conclusions as to applications from the Senate of the University of London for maintenance grants in aid of incorporated schools and institutions maintained by the University. After reviewing the conditions in the various colleges, the following resolutions were eventually adopted:—"That the Senate of the University of London be invited to prepare and submit to the Council a statement of the policy which it intends to pursue pending the publication of the report of the Royal Commission on University Education in London, together with an estimate of the additional assistance (if any) which may be required from the Council to enable such policy to be carried out." "That, on receipt of the statement and estimate referred to in the foregoing resolution, the Council will be prepared to consider as to the amount of assistance it should give to the University during the academic years 1911–12, 1912–13, and 1913–14; and that the Senate be so informed." "That the Council is not prepared, during the period of three years referred to in the foregoing resolution, to consider any applications for further maintenance grants either for the educational work conducted directly by the University or for the maintenance of the incorporated schools; that the Council does not undertake to continue, after the expiration of the above period of three years, any grant which it may decide to make to the University under the above-mentioned recommendations; and that the Senate be so informed." The committee thinks it is of great importance that it should be clearly laid down that any grant which may be given will be strictly temporary. On the publication of the report of the Royal Commission the whole question of the future government and policy of the University will have to be dealt with, and, among other important questions, that of the relation of the University to the schools which are at present incorporated will come up for discussion. The London County Council, as the authority for higher education in London, should be able, the committee maintains, to impress its views upon these matters upon Parliament and the governing body of the University. The most effective way in which the Council can impress its views is by means of its maintenance grants, and the committee thinks that it must be made clear that the Council will be in no way pledged to continue any grant which it may decide to make to the University at the present time.

THE annual meeting of the Association of Teachers in Technical Institutions was held on November 4. In moving the adoption of the report of the council, Mr. North, the president, directed attention to the evidence which had been given by the association to the Royal Commission on the London University, emphasising the necessity for the formation of an autonomous faculty of technology within the University, and urging that the Imperial College of Science, the London polytechnics, and possibly some provincial technical institutions should form constituent elements of this faculty. In discussing the recent Board of Education circular relating to the new scheme of examinations and grouped courses, he regretted the hasty manner in which the scheme of the Board had been brought into operation. The circular showed a lack of practical knowledge of the actual conditions of the work in technical institutions comparable with that displayed by the Board in the changes introduced last year in the matter of registration. Mr. North referred also to the steps which had been taken by the council in the direction of securing the presence of teachers from technical institutions upon all local advisory committees dealing with juvenile employment. In seconding the adoption of the report, Mr. Abbott, the honorary secretary, pointed out the necessity for the association to continue its efforts for the development of technical education. At the present time technical education in England, if not actually on the down-grade, is stationary. The returns recently published by the Board of Education for the session 1909–10 show that the number of day students in technical institutions is slightly lower than that in the previous session, while the number of evening students is practically the same. After the adoption of the report a discussion was opened by Prof. Schwartz upon the changes recently made by the Board of Education with regard to the abolition of all first-stage examinations and the withdrawal of all examinations in certain subjects. He welcomed this change as one which would lessen the weight of external examinations, which have, up to the present, lessened the real educational work of the technical institutions. He advocated the replacement of the external examinations in Stage i. by internal examinations in the case of the larger institutions, and possibly by groups of institutions for the smaller schools. The president of the association for the year 1911–12 is Dr. J. Clark, rector of the Kilmarnock Academy, and director of technical education for Kilmarnock.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 2.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir W. de W. **Abney**: Colour-blindness and the trichromatic theory of colour-vision. Part iii.—Incomplete colour-blindness. The first part of the paper shows how, if an equation be formed by rays in known position in the spectrum to match a white, by normal vision and by the colour-blind, the two can be compared together without special reference to the luminosity of the matched white. The luminosities of all the rays are known in the one case, and only two in the second, and from the two matches the unknown deficiency of colour sensation can be calculated. Owing to the fact that large quantities of their white can be mixed with the colours without being detected by those incompletely colour-blind who have a small factor for one of their sensations, a very false interpretation of their colour-blindness might be arrived at by the method described above. If, however, the luminosity of the composite white and the matched white be carefully equalised, a full determination of the colour deficiency can be arrived at by treating the equation somewhat in the manner described in part ii. of this same subject, when a true result is obtained. The latter part of the paper dealt with colour equations made from the rotation of discs; and it is shown that trustworthy results can be obtained from their use so long as the sensations stimulated by the pigments in the light in which they are viewed are known in amount. The method of ascertaining the sensation composition of the pigments, and of the light used for their illumination, is described. When once these are known, no further appeal to the spectrum is required. The author recommends the use of a white light passing through a yellow substance, such as chromate of potash solution, as a viewing light, in which only the red and green pigments are required in the inner disc, the blue not being wanted. The "grey" match becomes thus much brighter and is easier to read.—H. R. A. **Mallock**: Note on the iridescent colours of birds and insects. In this note reasons are given for the view that certain forms of brilliant coloration which occur in the feathers of birds and in the scales and integuments of insects are due to interference, and are of the nature of the colours of thin plates. Walter, in 1895, in Germany, and quite recently Michelson in America, have written on this subject, and, basing their opinions on the behaviour of polarised light when reflected from the colour-producing surfaces, conclude that the colours are due to selective absorption and reflection, and are akin to those reflected from certain anilin dyes and from metals. The reasons against this view and in favour of interference are (1) that when any of these natural colour-producing structures are penetrated by a fluid having the same refractive index as that of the material of which the structure is composed, the colour disappears; (2) when the refractive index of the fluid is less, the colour does not disappear altogether, but changes towards the red; (3) (which is perhaps the most important) under mechanical pressure the colours first change towards the red and then (as the pressure increases) disappear. These results are what might be expected from a structure which produces interference, and it is difficult to reconcile them with any other hypothesis. The note is founded on observations, extending over many years, on examples of this class of colour production taken from a considerable number of orders and genera, both of birds and insects, and the methods of examination employed are shortly described.—K. R. **Lewin**: The behaviour of the infusorian micronucleus in regeneration. When *Stylonychia mytilus* is cut in two, so that each merozoon receives one member of the meganucleus and one micronucleus, both fragments exhibit in favourable circumstances complete regeneration. This involves segmentation of the meganuclear member and division of the micronucleus. If a portion of the cytoplasm be removed from the hind end of the animal without disturbing the nuclei, there may occur during regeneration a division of one, usually the posterior, micronucleus. The result is to furnish the regenerated infusorian with three micronuclei instead of two, *i.e.* the division does not restore, but actually disturbs, the nuclear relations characteristic of the race. When the regenerated individual proceeds to fission, all three micronuclei divide. That an extra division can be introduced into the normal cycle of mitoses shows that the organella is in a fit state to divide before the whole animal is ready for spontaneous fission; that the supernumerary mitosis occurs during regeneration suggests that the stimulus causing the micronucleus to divide may be the condition of the surrounding cytoplasm which obtains during the constructive activities of regeneration. The cases in which regeneration occurs without either of the micronuclei dividing can be supposed to be those in which either the micronuclei were not ripe for mitosis or the stimulus was not sufficiently intense to evoke a division—by reason, *e.g.*, of regeneration occurring slowly, with no great intensity of constructive processes at any time. At the normal fission of the animal, when all the micronuclei present divide, there is a general formation of new parts quite comparable with the localised activity in regeneration, and accomplished, it is natural to suppose, with much the same condition of the cytoplasm. The normally occurring mitoses, and those taking place during regeneration, can thus be brought under one point of view.—A. F. **Hayden** and W. P. **Morgan**: An inquiry into the influence of the constituents of a bacterial emulsion on the opsonic index. These experiments, so far as they have gone, show that in the technique of the estimation of the tubercle opsonic index the quantity and character of the contents of the bacterial emulsion must be taken into account, and that the chief factor influencing the estimation is the finely ground bacterial detritus resulting from the process of triturating the dried culture of the bacillus.—Colonel Sir David **Bruce**: The morphology of *Trypanosoma gambiense* (Dutton).—A. H. **Caulfeild**: (1) Factors in the interpretation of the inhibitive and fixation serum reactions in pulmonary tuberculosis; (2) preliminary report upon the injection of rabbits with protein-free (tuberculo-) antigen and antigen-serum mixtures.

Physical Society, October 27.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Hon. R. J. **Strutt**: Further observations on the afterglow of electric discharge and kindred phenomena. It is shown that ozone prepared by means of the Siemens ozone tube used at atmospheric pressure is able, when mixed with nitric oxide, to give the greenish-yellow afterglow flame. This result is only attained, however, when the ozone has been concentrated by fractional distillation. A blue glow is obtained under the same conditions with sulphuretted hydrogen and ozone. The effect of sulphur compounds in improving the air-glow noticed by the older experimenters is shown to be due, not to any direct intervention of these bodies in the reaction, but to their power of destroying organic matter prejudicial to ozone. When once this is got rid of, the sulphur compounds are of no further advantage. It is found that pure oxygen does not give an afterglow. The afterglow seen in electrodeless bulbs containing oxygen is due to some interaction with water vapour. The luminosity given out when ordinary spring water is shaken with ozone is shown to be due to oxidation of peaty matter contained in it. Brown peat water gives greatly enhanced luminosity.—Prof. C. G. **Barkla** and J. **Nicol**: Homogeneous fluorescent X-radiation of a second series. It was shown by one of the writers that the fluorescent X-radiations emitted by elements exposed to primary Röntgen radiation can be arranged in series, one radiation in a particular series being emitted by each element, and the radiation belonging to that series becoming more penetrating with an increase in the atomic weight of the radiating element (Proc. Camb. Phil. Soc., May, 1909). The homogeneity of radiations of only one series (the K series) was shown by Barkla and Sadler. This paper describes experiments showing the homogeneity of fluorescent X-radiations in the second series (the L series), and exhibiting the homogeneity of radiations of the two series from a number of elements. Details are given of the observations on the radiations from barium. Similar results are recorded in the case of the radiations from iodine, antimony, and silver. The homogeneous fluorescent radiations of different series are emitted simultaneously by an element exposed to Röntgen radiation of more penetrating type than either. The fluorescent X-radiations can

thus be analysed into well-defined radiations widely different in penetrating power, and may be said to give a line spectrum in X-rays. The absorbability of the fluorescent radiations is given by the following values of λ/ρ, where λ is the coefficient of absorption of these radiations in aluminium of density ρ:—

Ag radiation:	(Series K)	[2·5];	(Series L)	700
Sb	,,	1·21	,,	435
I	,,	0·92	,,	300
Ba	,,	0·8	,,	224

Paris.

Academy of Sciences, October 30.—M. Armand Gautier in the chair.—B. **Baillaud**: Presentation of two volumes of the "Annales de l'Observatoire de Paris."—Ch. **André**: The formation of suns. Referring to recent adverse criticisms of Laplace's theory, the author maintains that recent physical researches confirm this theory.—A. **Demoulin**: The R surfaces.—Eugenio Elia **Levi**: Periodic differential equations.—Paul **Dienes**: The summation of Taylor's series.—Henry **Hubert**: The parabolic form of the exposed acid crystalline rocks in western Africa. The water erosion takes place only at the expense of granitic rocks, and is characteristic of certain regions. The effect of the motion of the cutting particles is shown to result in a curved outline.—G. **Millochau**: Contribution to the study of the spectral effects of electric discharges in gases and vapours. The image from a vacuum tube containing the gas under examination at a known pressure is projected on to a circular photographic film rotating at a high known velocity. Seven kinds of simple discharge are described, and three types of mixed discharge. All the results are in accord with hypotheses which connect the production of the spectrum with the temperature of the molecule and the dissociation effects corresponding with that temperature.—Albert **Colson**: The theory of solutions and heats of solution. The author regards the identification of the dissolved particle with the chemical molecule as inadmissible, and considers that the dissolved particle is generally polymolecular. He suggests *dissolecule* as a distinctive name for the dissolved particle. The difference between the heat of solution of a gas and its heat of condensation, which should be zero according to the van 't Hoff hypothesis, represents the heat disengaged by the molecular contraction giving rise to the dissolecule.—MM. **Broniewski** and **Hackspill**: The electrical properties of the alkali metals, of rhodium, and of iridium. Measurements are given of the thermoelectric power of cæsium, rubidium, potassium and sodium, and of rhodium and iridium. The purification of the alkali metals was effected by distillation in a vacuum.—G. D. **Hinrichs**: The atomic weights of the dominant elements.—E. **Chablay**: The use of liquid ammonia in chemical reactions. Researches on the alcoholates. An alcohol dissolved in liquid ammonia immediately decolorises a blue solution of potassammonium or sodammonium, hydrogen, ammonia, and the anhydrous alcoholate RONa being formed. A blue solution of calcium-ammonium reacts similarly, the calcium alcoholate being formed. Barium and strontium ammoniums act similarly.—Maurice **Lanfry**: The oxy-β-methylthiophenes.—MM. **Taffanel** and **Dautriche**: The mode of firing explosives. In blasting in mines one cartridge containing fulminate is usually arranged to explode several cartridges containing safety explosive only. Experiments are described showing the most advantageous arrangement of the fulminating cartridge with respect to the others.—Jean **Friedel**: The effect on vegetation of a more complete darkness than that currently employed in laboratories. A box for growing plants in the dark is described in which the exclusion of light is so perfect that a delicate photographic paper is unaffected after prolonged exposure. The results on the plants are compared with those obtaining under ordinary conditions, in which the exclusion of light is not so perfect.—Pierre **Berthault**: The variations of tuberiferous Solanum.—P. **Desroche**: The action of various light radiations on the motion of the zoospores of Chlamydomonas.—A. **Marie** and A. **Bonnadieu**: Leucogenesis and intestinal epithelium.—A. **Magnan**: Human monsters.—Pierre **Georgevitch**: The formation and germination of the spores of *Bacillus thermophilus vragnensis*.—Louis **Gentil**: The country of Zaër, western Morocco.—Maurice **Lugeon**: The existence of two phases of Palæozoic foldings in the western Alps.—Carl **Renz**: The extension of the Palæozoic formations in the islands off the coast of Argos.—Fernand **Meunier**: The Blattidæ of the Commentry Coal-measures. The lake of Commentry would appear to have been inhabited by a fauna of Blattidæ, less rich than in the American deposits, and represented by a very small number of genera, some of which possessed extremely prolific species.—Ch. **Moureu** and A. **Lepape**: The rare gases in fire-damp. Analyses of five specimens of fire-damp collected under conditions excluding air. One striking fact brought out by these analyses is the much higher proportion of helium to nitrogen than that existing in air. The nitrogen from the Mons specimen contained no less than 13 per cent. of helium.

BOOKS RECEIVED.

Die Palaeobotanische Literatur. Bibliographische Übersicht über die Arbeiten aus dem Gebiete der Palaeobotanik. Herausgegeben von W. J. Jongmans. Zweiter Band. Pp. iv+417. (Jena: Fischer.) 18 marks.

Die Bearbeitung des Glases auf dem Blasetische. By D. Djakonow and W. Lermantoff. Zweite Auflage. Pp. xv+196. (Berlin: R. Friedländer & Sohn.) 6 marks.

A Naturalist on Desert Islands. By P. R. Lowe. Pp. xii+300. (Witherby and Co.) 7*s*. 6*d*. net.

Psychology and Pedagogy of Writing: a Résumé of the Researches and Experiments bearing on the History and Pedagogy of Writing. By Dr. M. E. Thompson. Pp. 128. (Baltimore: Warwick and York Inc.)

Mental Fatigue: a Comprehensive Exposition of the Nature of Mental Fatigue, of the Methods of its Measurement and of their Results, with Special Reference to the Problems of Instruction. By Prof. Max Offner. Translated by Prof. G. M. Whipple. Pp. viii+133. (Baltimore: Warwick and York Inc.)

Der Panamakanal. Die Bedeutung des Kanalbaues seine Technik und Wirtschaft. By M. D. Fiegel. Pp. vii+183. (Berlin: D. Reimer.) 4 marks.

Islands of Enchantment: Many-sided Melanesia Seen through many Eyes, and Recorded by F. Coombe. Pp. xxvii+382. (London: Macmillan and Co., Ltd.) 12*s*. net.

Manual of Farm Animals: a Practical Guide to the Choosing, Breeding, and Keep of Horses, Cattle, Sheep, and Swine. By Prof. M. W. Harper. Pp. xxv+545. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Laughter: an Essay on the Meaning of the Comic. By Prof. H. Bergson. Authorised translation by Cloudesley Brereton and F. Rothwell. Pp. vii+200. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

Sir John Burdon Sanderson: a Memoir by the late Lady Burdon Sanderson, completed and edited by his Nephew and Niece, with a selection from his papers and addresses. Pp. 315. (Oxford: Clarendon Press.) 10*s*. 6*d*. net.

Die Silicate in Chemischer und Technischer Beziehung. By Drs. W. and D. Asch. Pp. xv+409. (Berlin: Springer.) 16 marks.

Cours de la Faculté des Sciences de Paris. Leçons sur les Hypothèses Cosmogoniques Professées à la Sorbonne. By H. Poincaré. Rédigées par H. Vergne. Pp. xxv+294. (Paris: Hermann.) 12 francs.

Astronomy. By A. R. Hinks. Pp. 256. (London: Williams and Norgate.) 1*s*. net.

Introduction to Science. By Prof. J. A. Thomson. Pp. 256. (London: Williams and Norgate.) 1*s*. net.

Confessions of a Robin. By Lieut.-Col. A. F. Mockler-Ferryman. Pp. 192. (London: S.P.C.K.) 2*s*.

Geometry for Schools. By W. G. Borchardt and the Rev. A. D. Perrott. Vol. i. Pp. viii+52 and Answers. Vol. ii. Pp. viii+53 to 162 and Answers. (London: G. Bell and Sons, Ltd.) 1*s*. and 1*s*. 6*d*.

The Enzyme Treatment of Cancer and its Scientific Basis. By Dr. J. Beard. Pp. xix+290. (London: Chatto and Windus.) 7*s*. 6*d*. net.

Chemistry and Chemical Magic. By V. E. Johnson. Pp. 150. (London: H. Frowde and Hodder and Stoughton.) 1*s*. 6*d*.

Mechanics and some of its Mysteries. By V. E. Johnson. Pp. 120. (London: H. Frowde and Hodder and Stoughton.) 1s. 6d.

Flying and some of its Mysteries. By V. E. Johnson. Pp. 138. (London: H. Frowde and Hodder and Stoughton.) 1s. 6d.

Modern Science Reader, with Special Reference to Chemistry. Edited by Prof. R. M. Bird. Pp. viii+323. (London: Macmillan and Co., Ltd.) 5s. net.

Lehrbuch der Protozoenkunde. By Prof. F. Doflein. Dritte stark vermehrte Auflage. Pp. xii+1043. (Jena: Fischer.) 26 marks.

Geologische Charakterbilder. Herausgegeben von Prof. H. Stille. Heft 2–8. (Berlin: Gebrüder Borntraeger.) Various prices.

The Climate of the Continent of Africa. By A. Knox. Pp. xiv+552. (Cambridge University Press.) 21s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 9.

ROYAL SOCIETY, at 4.30.—The Spectrum of Boron: Sir W. Crookes, O.M., For. Sec. R.S.—A Chemically-active Modification of Nitrogen produced by the Electric Discharge. II.: Hon. R. J. Strutt, F.R.S.—Production of Solid Oxygen by the Evaporation of the Liquid: Prof. Sir J. Dewar, F.R.S.—On the Gaseous Condensable Compound, Explosive at Low Temperatures, produced from Carbon Disulphide Vapour by the Action of the Silent Electric Discharge. II.: Prof. Sir J. Dewar, F.R.S., and Dr. H. O. Jones.—(1) Optical Dispersion: a Comparison of the Maxima of Absorption and Selective Reflection for certain Substances; (2) The Influence of the Solvent on the Position of Absorption Bands in Solutions: Dr. T. H. Havelock.—An Experimental Investigation of Gibbs's Thermodynamical Theory of Interfacial Concentration in the Case of an Air-water Interface: Prof. F. G. Donnan, F.R.S., and J. T. Barker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Modern High Voltage Power Transformers in Practice with special reference to a "T" Three Unit System: W. T. Taylor.

THE CONCRETE INSTITUTE, at 8.—Presidential Address: Sir Henry Tanner, C.B.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Invariants of the Linear Partial Differential Equation of the Second Order in Two Independent Variables: J. E. Campbell.—On Invariants of a Canonical Substitution: H. Hilton.—The System of Lines of a Cubic Surface: C. T. Bennett.—The Relations between Borel's and Cesaro's Methods of Summation: G. H. Hardy and J. E. Littlewood.—A Method of Establishing the 27-line Configuration of a Cubic Surface: W. P. Milne. Mathematical Analogues of Mental Phenomena: H. Bateman.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Nouvelles étoiles doubles, 6me série: R. Jonckheere.—Empirical Short Period Terms in the Moon's Mean Longitude: F. E. Ross.—(1) Mean Areas and Heliographic Latitudes of Sun-spots in the Year 1910; (2) Observations of Jupiter's 8th Satellite: Royal Observatory, Greenwich.—The Influence of Anomalous Dispersion on Solar Phenomena: P. V. Bevan.—Astrographic Measures of Double Stars: R. W. Wrigley.—On the Errors of Measurements on Photographic Plates: Winifred Gibson.—Fifth Note on the Number of Faint Stars with Large Proper Motions: F. A. Bellamy.—The Spectrum of Nebulium: J. W. Nicholson.—*Probable Paper:* Possible Phase Relations between the Planets and Sun-spot Phenomena: F. J. M. Stratton.

PHYSICAL SOCIETY (at Finsbury Technical College), at 5.—Reflecting Polariscopes for the Study of Optical Stress in Materials: Prof. Silvanus P. Thompson and Prof. E. G. Coker; The Effects of Holes and Semicircular Notches in the Distribution of Stress in Tension Members (demonstrated by polarised light): Prof. E. G. Coker.—(1) A Surface-tension Phenomenon; (2) Temperature Rise in Drops as they Part; (3) Temperatures of Equidensity of Liquids: Mr. C. R. Darling.—(1) Exhibition of a Large Harmonograph; (2) Physiological Effect of an Alternating Magnetic Field; (3) Demonstrations of Acoustical Experiments, New and Old: Prof. S. P. Thompson.

TUESDAY, NOVEMBER 14.

MINERALOGICAL SOCIETY, at 5.30.—On Crystals of Dufrenoysite, Seligmannite and Rathite: R. H. Solly.—A Simple Graphic Method for Determining Extinction-angles in Sections of Biaxial Crystals: H. G. Smith.—On the Meteoric-stone which recently fell in Egypt: Dr. G. T. Prior.—Strüverite from the Federated Malay States: T. Cook and S. T. Johnstone.—On the Temperature at which Gypsum becomes Uniaxial: A. Hutchinson.—On a Total-reflexion Diagram: A. Hutchinson.—The Occurrence of Ankerite in Coal: T. Crook.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Malulu Mountain People of British New Guinea: R. W. Williamson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Loch Leven Water-power Works: A. H. Roberts.—The Hydro-electric Plant in the British Aluminium Company's Factory at Kinlochleven: F. B. Sonnenschein.

WEDNESDAY, NOVEMBER 15.

ENTOMOLOGICAL SOCIETY, at 8.—Descriptions of South American Microlepidoptera: E. Meyrick, F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Abnormal Summer of 1911: C. Harding.—Notes on Solar Halos: W. Larden.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Geometric Slide Photo-micrographic Apparatus: J. E. Barnard.—British Enchytræids. II. The Genus Fridericia: Rev. Hilderic Friend.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Discovery of a N... Type of Flint Implements below the Base of the Red Crag of Suff... proving the Existence of Skilled Workers of Flint in the Pliocene A... Sir Ray Lankester, K.C.B., F.R.S.—The Influence of Ionised Air ... Bacteria: Prof. W. M. Thornton.—The Permeability of the Yeast Ce... S. G. Paine.—The Intrinsic Factors in the Act of Progression in ... Mammal: Dr. T. G. Brown.—Ventilation of the Lung during Chlorof... Narcosis: G. A. Buckmaster and J. A. Gardner.—The Refractive Indi... of the Eye Media of some Australian Animals: Dr. J. L. Jona.—Stu... in Heredity. I. The Effects of Crossing the Sea-urchins, *Echin... esculentus* and *Echinocardium cordatum*.

INSTITUTION OF MINING AND METALLURGY, at 8.—*Adjourned D...cussions:* (1) Fallacies in the Theory of the Organic Origin of Petroleu...: Eugene Coste; (2) The Economics of Tube-milling: H. Standish B...—*Paper:* The Whim Well Copper Mine, West Pilbara, North-w... Australia: H. R. Sleeman.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Endurance o... Metals: Experiments on Rotating Beams at University College, Lond...: E. M. Eden, W. N. Rose, and F. L. Cunningham. (*Adjourned Discussi...n*)—*Probable Paper:* Double-cutting and High-speed Planing Machi...: J. Hartley Wicksteed.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Notes on the Design ... Motor-car Headlights: Dr. H. R. B. Hickman.

CONTENTS.

THURSDAY, NOVEMBER 16, 1911.

CELLULOSE DERIVATIVES IN THE SERVICE OF MAN.

Nitrocellulose Industry: a Compendium of the History, Chemistry, Manufacture, Commercial Application, and Analysis of Nitrates, Acetates, and Xanthates of Cellulose as Applied to the Peaceful Arts; with a Chapter on Gun-Cotton, Smokeless Powder, and Explosive Cellulose Nitrates. By Dr. Edward C. Worden. Vol i., pp. xxxiv+565. Vol. ii., pp. xxviii+567–1239. (London: Constable and Co., Ltd., 1911.) Price, two vols., 42s. net.

WHEN Schönbein first announced his discovery of gun-cotton little could he have foreseen that he was laying the foundation of so many important industries as those, sixty-five years later, associated with cellulose derivatives, for although the acetates and xanthates of this parent substance are daily growing in importance, their introduction has solely been due to the wide and successful application of the nitrocelluloses. One may safely say that the derivatives of no other single chemical substance (if cellulose in its varied forms may be so termed) have proved of such general use to mankind, assisting in the production at a cheap rate of numbers of articles hitherto made from expensive natural products, developing important branches of photography, rendering valuable service to the man of science and medical man, and finally furnishing the base of all the modern smokeless powders. The author has succeeded in these two comprehensive volumes in admirably treating of all the discoveries and applications of these highly important derivatives. The magnitude of such a work and the thoroughness with which it has been carried out may be realised from the fact that more than 8000 literature references and 5000 patent references have been verified.

The preparation of the nitrocelluloses and their stabilising is of the first importance, and is very clearly dealt with. An important point is the effect of prior treatment of the cotton, before nitration, on the character of the product and its stability. In general cotton treated with bleaching powder solutions or mercerised by alkali gives a lower nitrogen content, a greater ether-alcohol solubility, and renders subsequent stabilisation more difficult.

The successful application of nitrocelluloses in the arts is almost wholly dependent on the use of proper solvents and obtaining solutions of the desired viscosity. The important part which amyl alcohol (*iso*), introduced by Stevens in 1882, has played in the artificial leather, lacquer, and other industries is paralleled by the important property of camphor in forming solid or suitable plastic bodies for other branches of the industry. The author estimates that some 450,000 gallons of amyl acetate are annually employed in the United States, so that he rightly devotes considerable space to its preparation and the chemistry of camphor also receives very full treatment.

Space does not permit of more than a brief reference to the numerous applications of nitrocellulose or the other derivatives; it seems that in one way or another they must have some interest for everyone, but especially for those engaged in any branch of science. The preparation of museum specimens, and particularly of sections for the microscope; for preservation of important writings by saturation of the paper (where Indian ink has been employed, of which shellac is a constituent and soluble in the nitrocellulose solvent—the paper must first be immersed in a 2 per cent. solution of gelatin and allowed to dry); for the production of special tubes for deep-sea soundings, the tubes being coated inside with silver chromate, are amongst the minor but still important applications of nitrocellulose solutions.

In the large industries built up on cellulose derivatives during the last twenty years mention may be made of its application in the manufacture of incandescent mantles, both for coating the mantle to enable it to withstand the shocks of transport and handling, and the production of mantles themselves by the ejection of filaments containing the thoria and ceria, to be afterwards woven into mantles; the production of pyroxylin containing imitation leathers, of which a conservative estimate of the daily output of the United States is 45,000 yards, and for photographic purposes, where the applications of soluble nitrocelluloses are so numerous that considerable space is devoted to the subject. The production of continuous films has undoubtedly contributed more than any other discovery to the popularity of photography, and rendered the kinematograph a possibility. The extreme desirability of using non-inflammable films is emphasised from time to time by the ignition of ordinary films, so that the description of the preparation of cellulose acetate films will prove of value and a useful guide to future inventors.

The production of artificial silk is a triumph of the application of chemical substances to rival one of the most beautiful products of nature. Whilst in the early days it was thought to be a rival to the natural product, its lack of flexibility and strength have precluded this actually being the case; but the beauty of the filaments has given rise to so many new and decorative materials that, although not a rival, the demand for the artificial product was, for a period, so great that its price actually exceeded that of the natural silk. A brief reference can only be made to the early process of Chardonnet (1884), in which, as in most processes, an ether-alcohol solution of nitrocellulose is employed. The fluid was at first squirted through an orifice 0·5 mm. in diameter, the spinnarets falling into cold water which coagulated, their exterior forming a tube with a liquid interior, this coarse thread being then rapidly spun out into a thin filament. Later the orifice was reduced to 0·08 mm. Nitrocellulose silks are usually denitrated by means of an alkaline sulphide, so that finally they are essentially cellulose. It is of interest to compare the diameter of the artificial fibre with the natural. Chardonnet silk is given as 45 to 60 micromillimetres, while the natural silk is only 9 to 15, these figures being for the wet (swollen) fibres.

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The chapter on the military applications of cellulose derivatives is limited to eighty-five pages, but these contain a vast amount of information which, although familiar to those associated with this branch of the subject, is an excellent condensation of information.

So wide are the applications of cellulose derivatives and so admirably is the subject treated by the author that his two volumes should find a place in every technical and scientific chemist's library, and, further, will prove an invaluable reference book for the large number who are regularly employing many of these important bodies in their everyday work.

J. S. S. B.

EDUCATION FOR THE COUNTRY LIFE.

The Teaching of Agriculture in the High School. By Garland A. Bricker. Pp. xxv+202. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 4*s*. 6*d*. net.

STUDENTS of rural affairs have long realised that much dissatisfaction exists in country districts with our present system of education. In whatever way it is judged, according to its critics, it has failed; the children sent out from the country schools are not better fitted for work on the land than their fathers were; on the contrary, they are kept at desk work during the period when it is supposed that their receptive faculties are at the best, and when they would, on the land, most rapidly learn the ways of animals, of plants, and of soils. Even the friends of the system will concede that it has been evolved without any special regard for country requirements, and without taking account of the fundamental differences in habits of thought and in points of view between the dwellers in the town and those in the country.

More and more it is being realised that the future development of the rural district, or to put it still more widely, of the country civilisation, must run on different lines from that of the city, and experiments are therefore being made to evolve a system of education that shall train children to lead the life of the country. The experimental scale is largest in the States, as one might expect, and in the book before us Mr. Bricker has collected such of the material as is at present available, thus usefully filling a gap in our education literature. It is, of course, as yet too soon to speak about results, but during the experimental period it is useful for educationists to know what their American *confrères* are doing.

Of the elementary school but little is said. The nature-study idea is for the present the best we have, and has already a copious literature of its own. The work of the elementary schools, according to the author, should confine itself to an elementary study of the common things of the farm, field, and forest. Something of the relative importance of these things to man should be studied and fixed in the mind of the child before he leaves school. It is in the secondary school, or, as it is here called, the high school, that the scholars will take up agriculture as such, but there is no break in the sequence of studies because agriculture will be looked upon as nature-study *plus* utility. But the study of agriculture is to be an education and not simply a manual training:

"If the essence of true culture is to see the fundamental and eternal shining out through the seemingly trivial and transitory, there is no subject better adapted to provide culture than the subject of agriculture."

To be treated in this broad way, agriculture requires a larger place in the school curriculum than the established secondary schools are able or willing to give it; hence the necessity for separate agricultural schools. Two possible dangers are indicated: specialised schools may emphasise class distinctions unworthy of a democratic country; education that makes a strong appeal to economic motives may be harmful if it places its powerful sanction on self-seeking ideals. The purely practical man, of course, will ask: Of what use are culture and adornment if the power to earn a livelihood is lacking? But this must not be the point of view of the agricultural teacher. He must rather insist on the other question: Of what use is the best capacity to make a living without a corresponding power to make life worth while? and make agriculture a cultural as well as a vocational subject. In short, the agricultural secondary school is to be the directive and constructive agent of the new rural civilisation that the best men in the States (and, for that matter, in this country also) are endeavouring to foster.

A chapter is devoted to the description of schools already established. They are, as one would expect, of several types, but in all of them boys and girls are educated together, entering at the age of thirteen or fourteen, and remaining for three or four years. Agriculture for the boys and household science for the girls form the respective centres of the courses, and the education is made as real as possible, *i.e.* the thing itself, whether a horse, a maize seed, or a growing crop, is before the class, and not simply a picture.

The author then proceeds to a discussion of methods. The logical arrangement of subjects followed in a college course is not the best for the boy with his limited experience and his incomplete and unorganised knowledge. It is necessary to adopt a psychological arrangement, *i.e.* a sequence of studies adapted to the changing and developing powers of the scholar. That the subject generally accords with the instincts and the impulses of the average boy is a tremendous help, and yet, unintelligently directed by the teacher, this help may prove a great danger. Into the psychological discussions we need not enter. The author's aim is to show that pedagogic principles can and should be applied to the teaching of agriculture, and that the subject can and should be made cultural as well as vocational.

The book affords a striking illustration of how much further the Americans have got than we ourselves. We are only commencing—if indeed we have seriously commenced—to apply the science of education in our agricultural teaching. Those who propose to essay the task will obtain useful help from this book.

E. J. R.

GLACIERS AND ICE-SHEETS.

Characteristics of Existing Glaciers. By Prof. W. H. Hobbs. Pp. xxv+301. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 13*s*. 6*d*. net.

THE framework of this volume was laid by Prof. Hobbs in three papers, dealing in turn with "Mountain Glaciation," "The Ice of Arctic Regions," and "Antarctic Ice," which were published during 1910 in scientific journals respectively in London, Philadelphia, and Berlin. The author has done good service to the glaciologist and glacial geologist in bringing together his concise description and classification of existing glaciers and ice-sheets in the present convenient form. Especially in the parts devoted to Arctic and Antarctic ice he has made an exhaustive digest of the scattered literature, and has presented a copiously illustrated summary of the available information respecting the distribution and character of the ice of these regions. To the end of each chapter he appends a full list of his authorities, so that the book is in every respect a most useful work of reference. His outlook is throughout that of a physiographer of the modern American school, and he has constantly in view the effect of ice and snow upon the shape of the land beneath it.

In his treatment of mountain glaciers, in the first (and shortest) part of his book, the author asserts himself more prominently than in the later parts, and it may be that some of his readers will consider the value of this part as a digest has, in consequence, been impaired. He reduces the existing Alpine glaciers to their really insignificant position by the aid of comparative diagrams (*e.g.* plate ii.). He will not allow that any of them, with the possible exception of the Great Aletsch, are worthy even of being called valley-glaciers—"In reality the glaciers of the Alps, far from occupying valleys, do not even fill the mother cirques at the valley heads" (p. 52). His rather elaborate classification of mountain glaciers (p. 42), based partly upon comparative alimentation, is not, however, likely to be generally adopted; most of the "types" are necessarily nothing more than phases which merge together indefinitely both in space and time-relation.

With respect to the long controversy as to the potency of ice as an eroding agent, Prof. Hobbs in his preface explicitly disclaims any intention to deal with "the views of that school of British geologists particularly which holds that the denudational effect of glacier ice is negative." So he does not refer to these views in adopting alternative explanations of the critical phenomena; *e.g.* the "Cascade Stairway" and the "Hanging Valley," in chapter iv. In this connection it may be remarked, though not mentioned by the author, that the long trench-like valleys by which the great glaciers pour down to the ice-plain of the Barrier from the high Antarctic plateau can scarcely be assigned to any other cause than ice-erosion.

In discussing the relation of mountain-form to glaciation, Prof. Hobbs dwells with particular emphasis upon cirque-development, which he believes to have a greater importance than has been generally recognised; and in this branch he takes upon himself the *rôle* of special pleader. For the initiation of a cirque through the agency of a snow-bank, he calls in the process of "nivation," *i.e.* selective perishing of contiguous moistened rock, as first suggested by Mr. F. E. Matthes from his observations in the Bighorn Mountains of Wyoming. In the later development of the cirque, the berg-schrund is considered to be a prime factor by the author, who has been duly—possibly even unduly—impressed by results of Mr. W. D. Johnson's celebrated exploration of the berg-schrund of Mount Lyell glacier, California, where the sapping of a perpendicular wall of rock was found to be in progress at the bottom of the fissure. The basis of observation is so limited that it may legitimately be questioned whether this sapping effect is general. However, the author considers that cirque recession is mainly responsible for the residual topographical forms of most high mountains, and he illustrates the progressive stages by good examples from western U.S.A., stating that "in parts of Europe, and in the Alps in particular, one looks in vain for evidences of the earlier and more significant stages," owing to the more prolonged and vigorous glaciation.

In final chapters the meteorological conditions of existing ice-sheets are summarised, and it is considered that the strong radial winds of Greenland and the Antarctic are due to the sliding outward of chilled air along the surface of the ice-dome.

The author fully recognises in other parts of his work the proved aridity of both polar areas, but passages on pp. 42–3 and 100–1 are likely to give the erroneous impression that the ice-caps are areas of heavy precipitation. At p. 238 there is an obvious misprint of Arctic for Antarctic.

Independently of the author's opinions on debatable matters, which may or may not be acceptable, every geographer and geologist interested in ice will appreciate these clear descriptions and excellent illustrations of the earth's great glaciers—they make up into a most presentable book.

G. W. L.

PRECESSION AND PARADOX.

Draysonia: being an Attempt to Explain and Popularise the System of the Second Rotation of the Earth, as Discovered by the late Major-General A. W. Drayson; also giving the Probable Date and Duration of the Last Glacial Period, and Furnishing General Drayson's Data, from which any Person of Ordinary Mathematical Ability is Enabled to Calculate the Obliquity of the Ecliptic, the Precession of the Equinoxes, and the Right Ascension and Declination of the Fixed Stars for any Year, Past, Present, or Future. By Admiral Sir A. F. R. de Horsey, K.C.B. Pp. ix+76+diagram. (London: Longmans, Green, and Co., 1911.) Price 3*s*. 6*d*. net.

GENERAL DRAYSON'S book on the "Motion of the Fixed Stars" is not a model of lucidity and generally fails to convince those who endeavour to grasp its argument. It was, therefore, most desir-

able that in selecting a commentator and literary executor the choice should fall on one who possessed the power of removing what was obscure in the theory and of placing the scheme in the most advantageous light. Admiral de Horsey has nothing to recommend him for the office he has undertaken but an unstinted admiration for the original author and a loyal desire to secure his recognition as a profound thinker. We respect and admire the sincerity of his conviction and his resolute effort to uphold the reputation of his departed friend. The struggle he has made is pathetic, but we regret to say he has only succeeded in darkening the issue.

General Drayson was dissatisfied with the theory of precession. He could not accept the explanation of the change of coordinates as due to the revolution of the earth's pole about that of the ecliptic, while at the same time the obliquity of the ecliptic was continually varying. He did not admit that the circular motion was a close approximation to the truth, and that greater accuracy was obtained by making the radius of the circle vary. Yet the device is a very usual one in the explanation of a recondite subject. It is often found that a broad general truth requires a minute degree of qualification. "The geometrical absurdity of a circle with a movable centre" seems to have presented a difficulty that the gallant General never mastered, and he therefore devised another plan for computing precession. Owing to the slow motion of the earth's pole, there is no difficulty in contriving an arithmetical process, by which the results when confined to a limited number of years shall be similar to those obtained by the ordinary formula. General Drayson's plan was to make the earth's axis revolve in a circle of radius 29° 25′ 47″, about a point 6° from the pole of the ecliptic, and situated near the solstitial colure. The annual motion of the point marking the origin of longitude (apparently not precisely coincident with the first point of Aries) is 40·89″, consequently the cycle of precession is about one-quarter longer than that assigned by astronomers.

Admiral de Horsey's contribution in support of his friend's theory has been to compute the precession of many stars by this method, and to compare the results with the Nautical Almanac values. The agreement is satisfactory, but if this proved anything one would think it proved the Nautical Almanac correct; but that view does not commend itself to the Admiral. Partly perhaps because in Drayson's method the obliquity of the ecliptic will vary in the course of a cycle between 23° and 35°, and thereby the glacial theory, provided that geologists could be satisfied with so short a period as 15,000 years, might be satisfactorily accounted for. The author also claims that some difficulties he imagines to exist in the reckoning of time can be removed by this means of explaining precession. He is not, however, very fortunate when he puts the late Mr. Stone in the witness-box to prove an anomaly in time reckoning. This may be a small matter, but when the author confuses precession with aberration we feel that, with the best intentions of serving the interests of his lost friend, he is scarcely fitted for the task.

THE MEASUREMENT OF ILLUMINATION.

Illumination; its Distribution and Measurement. By A. P. Trotter. Pp. xvii+292. (London: Macmillan and Co., Ltd., 1911.) Price 8*s*. 6*d*. net.

DEDICATED to Pierre Bouguer, the father of photometry, this book is the first really scientific attempt to put illuminating engineering on a proper basis, and is the outcome of the work which has been done in America and England of late years to break away from the haphazard methods of lighting which have so long been in vogue, and to replace them by arrangements of the sources of light which shall lead to a satisfactory distribution of light over the area to be illuminated.

No one more fitted to undertake this work than Mr. A. P. Trotter could have been found, and the experience he has gained since 1879, when he worked out his dioptric system of uniform distribution of light, has enabled him to produce a book which will prove invaluable to those who realise that the mere statement of the candle-power of a light offers no guide to its lighting effect, and that fifteen candles burning in different parts of a room give a very different illumination from one fifteen candle gas-jet burning in the chandelier.

The book very wisely is confined to the methods of distribution and measurement of illumination, and the portions dealing with photometry are more especially amplified in this direction, whilst all descriptions of systems of lighting have very properly been omitted.

The first chapter deals with the units and standards of candle-power, from the much-abused candle to the impracticable Violle melted platinum unit, but surely Mr. Trotter is a little unjust to the former when he says "the so-called English Parliamentary candle of spermaceti was not more scientific and hardly more accurate than the barleycorn of which three went to the inch." There are many photometricians of the old school who could assure him that the sperm standard candle, as made by Miller, when its use was guided by common-sense rather than by departmental directions, fell short of the modern standard in little else than convenience.

In the second chapter the author discusses "illumination and derived units," and it is pleasant to find due credit given to Sir William Preece, who, as early as 1889, recognised the necessity for a measure of illumination, and adopted the carcel-metre, to which unit he gave the name "lux," a name afterwards applied by the Geneva Congress in 1896 to the bougie-metre. The latter part of the chapter is devoted to a clear enunciation of the laws of light, flux of light, brightness, quantity, and reflection.

The distribution of illumination, more especially over a plane, occupies the next two chapters, and in the fifth photometers received full attention, and this chapter is of special value, as Mr. Trotter has introduced into it so much of his own work. It would have been even more interesting if he had criticised the various photometers from the point of view of the personal equation, as many observers would have liked to know his opinion of the Referees' table photo-

meter as compared with the open-bar disc photometer for general gas-testing work.

Several chapters are devoted to the minutiæ of photometric work, whilst in chapter ix. the measurement of illumination is dealt with, and another chapter describes the practical application of the methods employed, the work concluding with a valuable review of the subject of dioptric distribution of light.

The whole work is excellent from all points of view, and will form an addition to the engineer's and architect's library of far more than ordinary value.

MODERN GEOGRAPHY.

(1) *The Nations of the Modern World: an Elementary Study in Geography.* By H. J. Mackinder. Pp. xvi+319. (London: G. Philip and Son, Ltd.; Liverpool: Philip, Son, and Nephew, Ltd., n.d.) Price 2*s.*

(2) *A Geography of Ireland.* By O. J. R. Howarth. Pp. 224. (Oxford: Clarendon Press, 1911.) Price 2*s.* 6*d.*

(3) *Aberdeenshire.* By A. Mackie. Pp. x+198.

(4) *Huntingdonshire.* By the Rev. W. M. Noble. Pp. ix+152.

(5) *Worcestershire.* By L. J. Wills. Pp. ix+154. (Cambridge: University Press, 1911.) Price 1*s.* 6*d.* each.

(1) THE first of these works must not be regarded merely as a reading book for schools. It is, as its author observes, "a book of mingled geography and history," and contains so much matter that it was surely worthy of an index. While it develops the theme of three previous works, and brings out the bearing on human relations of the geographical conditions there described, it forms at the same time an independent treatise, which will stimulate the memory of many readers of full age. It is these, indeed, who will enjoy it thoroughly. A knowledge of modern history, and much of it obtained at first hand, is necessary for the complete appreciation of the changes of the map of Europe. Mr. Mackinder brings the older stages, such as those accompanying the Seven Years' War and the Napoleonic epoch, tersely and vividly before us. The later steps, the freeing of Venice, the partition of Lorraine, the uplifting of Bosnia, belong to our own eventful times. But we are led also to trace the rise of the United States and of Japan, and to take a large and scientific view of the inevitable expansion of Germany (p. 250), where men almost of our own blood are looking out also on the world. It may be somewhat ironic to suppose (p. 257) that the immense progress of Egypt under British organisation incited the Turks to improve their own home government; but the author's treatment of the British Empire as a whole forces a sense of responsibility upon the most insular and reluctant conscience. We may not like the reference nowadays (p. 258) to Japan and Turkey as "two heathen Powers," a phrase that has slipped in somehow from Mr. Mackinder's studies of the early nineteenth century; but his outlook is elsewhere that of the philosophic traveller. Under his direct and closely written sentences, we trace always that fine feeling for duty which is man's highest possession on this strange rotating globe.

(2) Mr. Howarth's "Ireland" is a welcome addition to the Oxford Geographies, a series edited by Prof. Herbertson. Aided by maps and excellent photographic illustrations, it brings the features of the country, grouped in natural regions, well before us. The author makes somewhat little (pp. 44 and 45) of Jukes's classic explanation of the courses of the southern Irish rivers, and seems to think that the Blackwater may have run against the face of an upraised fault-block at Cappoquin. Lamplugh's justly accepted explanation of the Scalp is neglected on p. 64, while the gorge of the Dargle is strangely described as having been deserted by its stream. Fig. 5, showing a drumlin-covered country backed by the Curlew Hills, is not so representative as it should be of "the Central Lowland," and the geological descriptions generally seem to date from the appearance of Hull's "Physical Geology and Geography of Ireland." We thus have Archæan granites (Fig. 3) opposed to large areas of "Cambrian and Silurian" strata in the metamorphosed regions; but the author himself must be held responsible for the insertion on his map of a Silurian district in the extreme south. Chapter xxvi. might be improved by an account of the cooperative organisation of agriculture, which has been largely aided by the fact that Ireland is a convenient and detached geographical unit. The publications of the Irish Department of Agriculture will assist Mr. Howarth in his next edition. The book has so many good points, and so clearly connects the structure of the country with the life of its inhabitants, that we hope it will meet with ready recognition.

(3) The county geographies issued by the Cambridge University Press, with their coloured physical and geological maps, and numerous landscape illustrations, have already taken a high rank. Aberdeenshire is largely a granite county, with solemn ice-worn highlands, and castles as stern as the jutting rocks along its coast. Mr. Mackie is a student of nature with a keen literary taste, and human interests and antiquities are evidently as attractive to him as are the birch-woods and the moors.

(4) The Rev. W. M. Noble's "Huntingdonshire" in the same series presents a very different country, where the fundamental rocks rarely appear from beneath the covering of glacial detritus and alluvial fenland. Too little emphasis seems to be laid (p. 31) on the high interest of the boulder-clay. The agricultural features, the great manor houses, and the stone bridges along the grand old highways are excellently illustrated and described.

(5) In "Worcestershire," Mr. L. J. Wills has a fascinating field. He describes the high ridge of Archæan granite in the Malverns, which rise on the western border like a blue wave against the evening sky. He illustrates the British formations up to the oolites of Bredon, and then directs attention to the upland vegetation of the Lickey Hills and the relics of old forests in the lowlands. The frosts in the hollows of the fruit-growing districts (p. 45) are, we presume, due to the creep of cold air downwards on still nights.

rather than to an increase in the amount of moisture present. A Severn coracle is figured (p. 87), and the antiquities lead us on to the stone houses of the Cotteswolds, and the unrivalled half-timber villages of the Trias plain. The chestnut-tree growing from a tomb in Kempsey Church (p. 140) may puzzle the reader who has not seen it. G. A. J. C.

MATHEMATICAL AND PHYSICAL CHEMISTRY.

(1) *Theoretical Chemistry from the Standpoint of Avogadro's Rule and Thermodynamics.* By Prof. W. Nernst. Revised in accordance with the sixth German edition by H. T. Tizard. (London: Macmillan and Co., Ltd., 1911.) Price 15*s.* net.

(2) *Higher Mathematics for Chemical Students.* By J. R. Partington. Pp. v+272. (London: Methuen and Co., Ltd., 1911.) Price 5*s.*

(3) *Abhandlungen der Deutschen Bunsen-Gesellschaft für angewandte physikalische Chemie.* Zweiter Band, Nr. v., Messungen elektromotorische Krafte galvanischer Ketten, mit wasserigen Elektrolyten. By R. Abegg, Fr. Auerbach, and R. Luther. Pp. x+213. (Halle a. S.: W. Knapp, 1911.) Price 8.40 marks.

(1) PROF. NERNST'S text-book occupies a special position amongst text-books of physical chemistry, written as it is by an author of such eminence as a pioneer and investigator in the science, and of such remarkable powers of exposition. From the chemical point of view no better basis for a work of the kind can be adopted than that of Avogadro's rule, for one of the main practical problems of the chemist is the determination of molecular concentrations. Gas densities, osmotic pressures, freezing and boiling points of solutions, conductivity of electrolytic solutions, and electromotive forces are all measured with this primary object in view, and therefore Avogadro's rule is at the root of them all. On this sound chemical basis, then, with the aid of the two laws of thermodynamics, the author has built. His ideas are always clear cut, his expression of them is always ordered and concise, and his mathematical proofs are of special neatness and brevity. It is no wonder, then, that although the book is scarcely intended for beginners, it should have reached a sixth edition in German and a third in English. The advanced student and teacher will specially welcome in this latest edition a detailed account of Prof. Nernst's new thermodynamical theorem, of which so much has been recently heard.

It is a matter for regret that the original English translation of Prof. Nernst's work was far from satisfactory, and so to a considerable extent spoiled the vogue of the book. The present translation has been revised and partly rewritten, and has without doubt been thereby vastly improved. But nothing short of complete retranslation could do justice to the original. However, an occasional awkwardly turned phrase of a distinctly Teutonic flavour will probably not greatly incommode the average reader, and so to all those who desire acquaintance with the facts and theories of physical chemistry and an indication of the lines of progress of the science, this translation of Prof. Nernst's excellent and unique work can be unreservedly recommended.

(2) Of all the mathematical books intended for the use of chemical students which have come under the notice of the present writer, Mr. Partington's is the most serviceable. The author has had a clear notion of the practical problem to be solved, and has performed his task successfully. He does not attempt to teach too much, and strictly adheres to what will be practically useful to the student of physical chemistry. Brief explanations of the nature of the mathematical processes employed are given, and their application is at once shown by well-selected examples. Thus convergent series are illustrated by the two examples of the washing of precipitates, and extraction from aqueous solution by means of ether; maxima and minima by the rate of catalysis of methyl acetate by water; the compound interest law by the decay of radio-activity; and so on. Alike to the chemical student who has no previous knowledge of the differential and integral calculus, and to the student who has learnt the methods of the calculus, but is at a loss how to apply them, this little book will be of considerable value.

(3) The Bunsen-Gesellschaft deserves the gratitude of those who work on the subject of electromotive force for the issue of the volume under review. It consists of three parts: (1) a complete systematic and chronological bibliography of measurements of electromotive forces; (2) a selection of the most trustworthy measurements reduced to a uniform system; and (3) tables of the most probable values of single electrode potentials.

In the bibliographical section the nature of the electromotive combinations measured is given, but not the numerical values obtained. Only aqueous solutions are considered, and such combinations as involve an agency external to the cell are excluded, *e.g.* thermoelectric and photoelectric combinations, d composition potentials, and the like. The arrangement is by elements according to the groups of the periodic table, both in the bibliographical and in the tabular sections; the single potentials are referred to the normal hydrogen electrode as zero.

With this book of reference at hand the worker at electromotive force can ascertain in the minimum of time what trustworthy work has already been done in his special branch, and see at a glance the most probable numerical values for any electromotive combination in which he may be interested. J. W.

OUR BOOK SHELF.

Field Note-book of Geological Illustrations. Arranged by Hilda D. Sharpe; containing 86 photographs and maps. Pp. 51. (Manchester: Flatters and Garnett, Ltd., n.d.) Price 3*s.* net.

THE idea of this book is a very happy one. Miss Sharpe has collected a number of photographs illustrating geological features, mainly from places in the British Isles, and Messrs. Flatters and Garnett are prepared to supply lantern-slides of most of them at 1*s.* each, or on hire at 1*s.* 3*d.* a dozen. Even as a supplement to the fine series issued by the British

Association, this selection is very welcome, and the book itself, at its modest price, is distinctly suggestive to the teacher. The illustrations, even when most effective, are rarely chosen from hackneyed subjects. We can scarcely do better than Stare Cove, Lulworth, or the Giant's Causeway, which naturally appear; but we can now avail ourselves of the limestone pinnacle of Pickering Tor, of eight views of the River Artro, near Harlech, from its source among the boulders to the sea, and of the Severn Valley in the Triassic plain of Worcestershire. Broad landscapes like the last have too often been neglected. Miss Sharpe gives us also the Silurian escarpments near Malvern, the rounded forms of the Longmynd, and the ice-worn gneissic floor of Sutherland. Details like an erratic near Harlech and pot-holes on the Gelt have also obvious uses. The subject may easily be extended into future volumes, if the enterprise meets with the success that it deserves.

A neat coloured geological map of the British Isles is given, but no useful purpose appears to be served by the insertion of tables of rock-forming minerals or of the classification of rocks, which cannot be regarded as either adequate or appropriate. The statements, moreover, made in this brief form are not always accurate. Opal is only partially described as "hydrated silica, brilliantly coloured." The term "glassy" applied to sanidine ought to have been long ago abandoned. "Carbonate of calcium" does not necessarily crystallise in rhombohedral crystals, since two forms are described below, one of which, aragonite, is here said to be triclinic. In the classification of the stratified rocks, "silica" and "silicates of alumina" are treated as minerals. These matters might be left with the text-books, to which the preface so properly refers.

Die Anzucht Tropischer Orchideen aus Samen. Neue Methoden auf der Grundlage des symbiotischen Verhältnisses von Pflanze und Wurzelpilz. By Dr. H. Burgeff. Pp. iv+90. (Jena: Gustav Fischer, 1911.) Price 3.50 marks.

It was announced by the French botanist, Noël Bernard, in 1904 that a symbiotic fungus inhabits the roots of many orchids, and that continued germination of the seed of such orchids is dependent upon the entrance of the fungus mycelium to renew the symbiotic union. This conclusion raised further problems, particularly whether the fungus differs in different orchids and how it may be isolated and inoculated. These are the practical points treated by Dr. Burgeff, who provides full instructions for raising seedlings in accordance with rigidly scientific principles. The methods are laborious. It is necessary to make pure cultures of the fungus, obtain aseptic seeds, mingle the two symbionts, grow them artificially, and transfer finally the young plant to natural conditions. The author also cultivated a number of mycelia taken from different plants with the view of distinguishing different varieties or species of fungus; the general result is indicated in a diagram showing that the mycelium of a given culture may serve for one, two, or rarely for more genera. Having thus shown how pure cultures should be made and described many experiments that he successfully carried out on these lines, he indicates a less troublesome method which consists in sowing the seed on sterilised fungus-infected soil.

It is unlikely that professional orchid growers will adopt either of the methods described, because it is in most cases an easy matter to raise seedlings under ordinary conditions by adding portions of the old roots or even soil from old cultures to the compost in the seed-pan. Nevertheless, the researches of Dr. Burgeff are theoretically and practically of great value, and should be carefully noted by growers, as they may serve to explain unexpected failures.

Elementary Applied Mechanics. By Prof. A. Morley and W. Inchley. Pp. viii+382. (London: Longmans, Green and Co., 1911.) Price 3s. net.

This book is intended for beginners of limited mathematical attainments, and, to meet the needs of such, extensive use is made of graphical methods and of numerical illustrations. Many worked-out exercises are included, together with others intended for solution by the student. Simple laboratory experiments are described. The standard is that of Stage I. of the Board of Education, and the method of treatment is quite orthodox. An introductory chapter on mensuration and measuring appliances is followed by chapters on elementary statical principles, leading up to the consideration of simple frames. Work, friction, and machines are then considered. Five very good chapters on the strength and elastic properties of materials are included, and the elementary laws of hydraulics form the subject-matter of the last three chapters.

The illustrations are clearly drawn, and are mostly correct. An exception occurs on p. 115, where a Prony brake is illustrated, having two mistakes in its design. In the chapters dealing with the composition and resolution of forces, it would have been better to omit the arrows shown on the triangles and polygons of forces. These cannot be shown on the force diagrams for frames, and a habit of inserting arrows which have to be omitted in subsequent diagrams is easier acquired than dropped by the beginner. We also observed several diagrams in which the resultant, found from the force diagram, has not been inserted in its proper place. The principal author is well known from his work on the strength of materials, and the present volume should take a good place among the other elementary text-books on the same subject already in existence.

The London University Guide and University Correspondence College Calendar, 1912. *Containing the Regulations for Examinations to be held in* 1912 *and* 1913. (London: University Correspondence College.)

The private student anxious to graduate at the University of London will find in this volume all the information he needs as to how to proceed. The best plan, in cases where it is possible, is for the student to enter one of the constituent colleges of the University and to follow the suitable course of study arranged for intending graduates; but for young men and women who are compelled to live far away from a college and whose time is occupied during the day, it would be difficult to find more helpful advice than this book contains.

Life in the Sea. By James Johnstone. Pp. vii+150. *New Zealand.* By Sir Robert Stout, K.C.M.G., and J. Logan Stout. Pp. viii+185. (Cambridge University Press, 1911.) Price 1s. net each.

Both these volumes belong to "The Cambridge Manuals of Science and Literature," a series which is fast becoming representative of every department of human knowledge. Mr. Johnstone provides a discussion of the general economy of the sea, in which the results of recent investigations of the microscopic life of the ocean are given due prominence. The object of the second book is to show faithfully in a brief way what New Zealand is and what has been done by her people, the treatment being such as is likely to appeal to readers who have not seen the Dominion.

These "Manuals" are not of the nature of primers

for young beginners; they are suitable, rather, for educated readers of maturer years, who desire to acquaint themselves with modern advances in the subjects in which they are interested.

L'Assaut du Pole Sud. By l'Abbé Th. Moreux. Pp. 221. (Paris: Jouve et Cie., 1911.) Price 1.50 francs.

THIS popular account of the various expeditions in Antarctic regions, arranged chronologically, will appeal to many readers. In English schools it might serve the double purpose of an interesting French text and leisure-hour reading in geography. The story is brought down to the present day and is illustrated, some of the pictures being views taken by Dr. Charcot on the *Pourquoi-Pas?*

Subject List of Works on Chemical Technology in the Library of the Patent Office. New Series, YN-ZB. Pp. iv+171. (London: The Patent Office, 1911.) Price 6*d*.

THE present list is concerned with oils, fats, soaps, candles, and perfumery; paints, varnishes, gums, resins, and india-rubber; and the paper and leather industries. With the volume, new series YK-YM, it supersedes "Patent Office Library Series, No. 7," published in 1901.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Late Sir Francis Galton.

I AM engaged on a memoir dealing with the life and work of the late Sir Francis Galton. He had a very wide correspondence, the width of which can only be appreciated by those who have seen the replies to his letters. Many of these are of great interest and value, and deal with important scientific problems. The main bulk of the letters start with 1885, although there are isolated letters from de Candolle, Speke, Buckland, Clerk Maxwell, and others from 1860 onwards. The letters from Francis Galton which led to these replies may still exist. May I appeal to any of your readers who have letters from Francis Galton to lend them to me for the preparation of this memoir? I should value especially any letters from 1850 to 1880; but all will be of value. Letters sent to me shall be carefully preserved, and returned if the owner desires it. Any letters which the owners are willing to present to this laboratory will be filed in the Galtoniana, which already contain many Galton manuscripts. KARL PEARSON.

Galton Laboratory for National Eugenics.

The Kaiser-Wilhelm Institut für physikalische Chemie und Elektrochemie at Dahlem, near Berlin.

ON October 1 Prof. F. Haber began his work as director of the new Kaiser-Wilhelm Institut für physikalische Chemie und Elektrochemie at Dahlem, near Berlin. The buildings of the institute, work upon which was begun during the summer of this year, are being erected by the Prussian Government working in conjunction with the "Koppel-Stiftung for the purpose of improving the intellectual relations of Germany with other lands."

The Koppel-Stiftung, which was founded in Berlin some years ago by Geheimer Kommerzienrat Leopold Koppel, and until now has maintained the German School of Medicine in Shanghai and the American Institute in Berlin, will provide the funds for the erection of the new institute, and will also give 35,000 marks annually for its maintenance during a period of ten years. The Prussian Government has provided the site, which is situated at the terminus of the new underground railway from the centre of Berlin to Dahlem, and has endowed the institute with the sum of 50,000 marks annually.

The institute will be controlled by a board consisting of two representatives of the German Government, two representatives of the Koppel-Stiftung, and the director of the institute. The director has an absolutely free hand in the choice of his work, his fellow-workers, and his assistants.

For the admission of investigators who wish to follow their own lines of investigation in the institute with their own means, the director must have the assent of the board of control.

The institute will consist of scientific and technical departments in separate buildings. The building of the scientific department is 600 square metres in ground area, and has a basement, entirely underground, containing constant temperature rooms. On the ground floor are the professor's laboratory and consulting room, the offices, the calibrating room in which are to be kept the necessary laboratory standards, the mechanic's workshop, and a lecture theatre to seat twenty-five persons. Further lecture-rooms are not provided in the building, as *teaching in the ordinary sense is not contemplated in the institute.* The first floor will be devoted to the library, chief assistant's room, glass-blowing room, and a laboratory for eight research men. On the second floor are the living rooms for the mechanic and his family, since the mechanic also acts as caretaker. This floor also contains rooms for photo-chemistry, for scientific collections, and workplaces for several more research workers.

The building is connected by a corridor with the technical department, the most important feature of which is the machinery hall, with a floor space of 200 square metres. This hall is surrounded by smaller rooms for chemical preparations, high-voltage and heavy-current work, and a blacksmith's shop. The ground floor of the technical building contains a consultation room and the laboratory of the assistant in charge of that department. On the first floor is living accommodation for two assistants and an engine-man, and also a room for the serving of refreshments.

The director's house will be erected in the grounds of the institute.

Although there exists no stipulation on the point, *it may be taken as a rule that, on account of the fact that no teaching as such is to be undertaken, only such students will be admitted by the director as have already finished their normal university course and desire a wider experience in scientific research.* There are no restrictions whatever as to the nationality of the men admitted by the director.

The director of the institute, Prof. Haber, was born in Breslau in 1868, and obtained his Ph.D. in Berlin in 1891. After obtaining his degree he spent several years partly in technical work and partly in securing further scientific training. In 1894 he went to Karlsruhe, and was appointed Privat-dozent in chemical technology in 18[illegible] and associate professor in 1898. In 1902 he was sent to America by the Bunsen Society of Applied Physical Chemistry to study the system of chemical instruction and the condition of electrochemical industries in the United States. In 1906 he was appointed to the post of professor of physical and electrochemistry in Karlsruhe, where he built up the best equipped research laboratory of physical chemistry in the world. Students from all parts of the world were attracted to this laboratory to such an extent that accommodation was insufficient to allow all of them to enter, even although Prof. Haber admitted as many as forty men at one time as research workers. What was most remarkable was that he personally directed the work of all these men, and often aided them in their experimental work. In 1907 he was called to take the place of Lunge in Zürich as professor of chemical technology, and in 1909 he was asked to undertake the control of one of the largest chemical works in Germany, but he declined both these appointments.

Prof. Haber introduced into Germany the rational method of instruction in elementary chemistry as embodied in the laboratory outline written by Prof. Alexander Smith. This book was translated into German by Prof. Haber and Fritz Hiller. The two books, "Lehrbuch der technischen Elektrochemie auf wissenschaftlicher Grundlage" (1898, now out of print) and "Thermodynamik technischer Gasreaktionen" (1905; English edition 1908), together with numerous contributions to the *Zeitschrift für Elektr*

chemie, *Wiedemann's Annalen*, and the *Zeitschrift für physikalische Chemie*, constitute his literary activities.

One of Prof. Haber's most important researches was that upon the ammonia gas equilibrium at high temperatures. This work resulted in the development of a commercial method for the manufacture of pure ammonia directly from the elements by the use of osmium or uranium as a catalyser. Another important series of researches was that upon the properties of flames, including the gas equilibria involved, the ionisation and conductivity of the gases, and the action of the ions as catalysers. He has spent much time during the last few years upon the study of the escape of electrons from the reacting surfaces of metals, and the effects of electrons upon gas equilibria and upon the velocity of chemical reactions. His other recent researches have been mostly upon the following subjects:—the electromotive force of the oxyhydrogen cell at high temperatures; the oxidation of nitrogen in the high-potential arc; a gas refractometer for the optical analysis of gases according to Rayleigh's principle; electrical forces at phase boundaries; the corrosion of iron by stray currents from street railways; the reduction of hydroxylamine; the use of solid materials, such as glass and porcelain, as electrolytes; the equilibrium between magnesium chloride and oxygen; electrode potentials and electrolytic reduction; the laboratory preparation of aluminium; the preparation of hydrogen peroxide by electrolysis; experiments on the decomposition and combustion of the hydrocarbons; and autoxidation.

The writer wishes to thank Dr. Fritz Hiller, of Berlin, for the greater part of the information contained in this letter. The statements in regard to the purposes and government of the institute are official.

WILLIAM D. HARKINS.

University of Montana, September 30.

The Weather of 1911.

THAT the year which is now drawing towards its close has been, as regards weather, a true *annus mirabilis* is a commonplace of conversation, and all the more so by reason of the contrast between this and last year. Not only has the summer been remarkable for its length, its heat, its brilliance, but the autumn, even since the weather was broken, has been characterised, unless I am mistaken, by an unusual tendency to relapse into bright sunshine: the storms have cleared up with great rapidity; the sunshine has been peculiarly clear, and mist and fog remarkably rare.

Now for these exceptional phenomena there must be some exceptional cause, or combination of causes. Can any of our meteorologists say what it is? I do not ask for a statement of causes such as the prevalence of anticyclones in a particular direction or the continuance of given winds, for such facts are only part of the phenomena to be explained; but I want to know whether any real cause can be assigned for the general character of the weather.

EDW. FRY.

Failand, November 8.

Dew-ponds in 1911.

THE pond near Chanctonbury, referred to by Mr. J. P. Eatworthy in NATURE of November 2 (p. 8), has generally been regarded as an ancient one; and I may perhaps direct attention to a statement in vol. lvii. of the "Sussex Arch. Collections" to the effect that it was made by the Rev. J. Goring, the father of the present owner. If this is correct, and the word "made" should not read as "re-made," there is, apparently, no ground for attributing the pond and its fortifications to Neolithic or any other ancient people.

A visit to St. Martinsell Hill, Wilts, on September 18 showed how disastrous had been the effects of the long drought. The pond near to the shepherd's cottage was dry except for a small circle of mud at the bottom. When normally full it could not have been more than 2 feet deep; and the whole area was strewn with loose angular flints. The occupier of the cottage stated that the pond had never previously dried up during the seventeen years he had been there. The sheep on the downs had nearly all gone, there being no "feed" for them. In short droughts the dew seems to be sufficient to maintain the "feed"; but this year the absence of rain for so long brought about a remarkable absence of dew, and the dependence of dew upon earlier fallen rain seems to be an established fact.

Another pond is to be seen about a quarter of a mile to the north of the cottage on level ground. It has a large hole in the centre some 5 feet deep. This pond was quite dry. A quantity of puddle had been removed from the depression.

Another pond-depression occurs south-west from the cottage and barn, at the beginning of the spit of down which here juts out over the low-lying land of the Vale of Pewsey. It is grass-grown, and has several Scots pines growing in it. There is no good reason to think it was a "quarry," or even a "tally-house," as has been alleged. It was dry.

Further west along this narrow spit of land, and beyond the great ditch and vallum known as Giants' Graves, is an empty pond-depression about 20 feet across, constructed in a most convenient position if only it had water. It has apparently been grass-grown for many years—another instance of the extraordinary neglect of modern-day farmers.

All these ponds were circular. On descending on the east of St. Martin's Hill towards Wootton Rivers, past a series of mounds like swellings on the side of the hills, called by some authors "pit-dwellings," I noticed a square pond at the edge of a field. This was also dry. But a little nearer Wootton Rivers, at the side of the road, was a pond full of water. This was on the low ground beneath the hills; and the secret of its success lay in the fact that it was almost surrounded by tall trees, some of which completely overhung the pond. Thus evaporation was reduced to a minimum in the heat of the summer sun, whilst it may have been replenished by the condensation on the leaves of the trees.

It was observed that a concrete pond was being built on a slight eminence in a field near at hand, and it was stated in the village that a boring was being made for water.

There is a moral. In the first place, farmers do not make their ponds deep enough. In the next place, they neglect them until they dry up. Finally, when they do repair them, they remove the puddle at the bottom in the process of cleaning, and then wonder why the ponds fail to hold water.

EDWARD A. MARTIN.

285 Holmesdale Road, South Norwood, S.E.

The Research Defence Society and Anti-Vivisection Shops.

WE desire to make a special appeal for the purpose of undoing the harm which is done by anti-vivisection shops and processions. The exhibits in these shops are of a most misleading nature: and the truth as to anæsthetics is carefully concealed. No operation, more than the lancing of a vein just under the skin, is allowed to be done on any animal in this country, unless the animal is under an anæsthetic throughout the whole of the operation.

It will be remembered that one of these shops, on the death of H.M. King Edward VII., distributed a leaflet suggesting that his Majesty's death was due to medical treatment.

We have, of course, received many complaints against these shops. We find that the police have no power to close them: and we can only place men outside them, to give our leaflets to passers-by.

But this constant giving of literature is a heavy expense to our Society. We therefore appeal for special contributions toward this purpose. We make this appeal with confidence, for we are sure that the public recognises the grave harm which is done by these shops, especially to children. All contributions should be sent to the Hon. Treasurer, Research Defence Society, 21 Ladbroke Square, London, W.

We may, perhaps, take this opportunity of mentioning that a letter has just been received from Sir Apolo Kagwa, K.C.M.G., the Prime Minister of Uganda. It is dated from Mengo, Uganda, September 26. "I really think," he says, "that in a few years' time sleeping sickness will be extinct in Uganda, and people will become immune from

the disease." If this happy result is obtained it will, without doubt, be due to the work done by the Royal Society Commission, who gained their knowledge on the subject by experimentation on animals.

CROMER, President.
SYDNEY HOLLAND, Chairman of Committee.
F. M. SANDWITH, Hon. Treasurer.
STEPHEN PAGET, Hon. Secretary.

21 Ladbroke Square, London, W., November 1.

The Definition of Mass.

IN NATURE for October 26 your reviewer, in criticising "An Elementary Text-book of Physics," writes:—

"In common with so many other text-books on this subject, this book lacks the fundamental definition of 'mass.' The author introduces the term 'mass' without definition in order to define force, and then uses this definition for the purpose of defining mass. Few writers on mechanics appear to realise that a definition of mass *apart from force* is the essential first step from the point of view of absolute measurement."

I am not concerned to defend this particular text-book, of which I have no knowledge, but I should be grateful, in common with many of your readers, if your reviewer would give us a satisfactory definition of mass *apart from force* (the italics are his own). I presume he would not be content with the fatuous statement that "Mass means quantity of matter"! Apparently Sir Oliver Lodge must be included amongst those censured, for in his "Elementary Mechanics" he writes:—

"We see, then, that mass is measured, and must be held to be defined, by the property of inertness possessed by matter—that is, by its requiring force to move it if at rest, and to stop it if in motion."

The same view is expressed by Clerk Maxwell in his invaluable little book "Matter and Motion," article xlvi.

Let us be frank about this question. The idea of force, like the idea of temperature, is derived from our bodily sensations, and is therefore suspect in some quarters. It is said that our sensations are not trustworthy. Nevertheless, we can form from them by long experience fairly accurate estimations both of force and temperature. To measure temperature we generally observe the expansion of a material body. To measure force we can use the deformation produced by it when acting on some portion of matter—the statical method; or we may measure the acceleration produced in a particular body—the dynamical method. The two methods give concordant results. We observe the effects of changes of temperature; we infer the passage of "heat" from one body to another. We observe the effects of force in producing acceleration. We find that the ratio of force to acceleration (or, what is equivalent, the ratio of impulse to change of velocity) is (approximately) constant for a particular body. We infer the existence of "mass," which is simply the value of this ratio. To say that "mass" is indestructible is to affirm that this ratio remains constant through the range of our experiments. If we extend the range we are led to believe that the ratio is no longer constant when the velocity of the body approaches the velocity of light.

H. S. A.

IT gives me much pleasure to comply with "H. S. A.'s" request expressed in his letter, but, at the same time, I should like to refer him to chapter iii. of Porter's "Intermediate Mechanics" for a clear and exact statement with regard to this question.

In the first place, it should be pointed out that definitions are of two kinds, qualitative and quantitative, and it was in the latter sense that the term was used in that portion of my review which "H. S. A." quotes. To the definition due to Lodge, regarded as purely qualitative, no objection is offered; it is when *quantitative* definitions are required for the purpose of measurement that the difficulties arise. Surely it is obvious that it is meaningless to define unit force as that which produces unit acceleration in unit mass, and then to define unit mass as that which acquires unit acceleration under the action of unit force. Of course, if we are content to define force in terms of the deformation it produces in a given piece of material, mass may then be measured in terms of force and acceleration; but the system of units arrived at will not be absolute. To obtain absolute units, we must be able to compare either two forces or two masses by measurements of space and time alone. The problem of defining mass quantitatively therefore resolves itself into defining the *ratio* of two masses in terms of space and time. This may be done as follows.

Let two masses m_1 and m_2 be isolated (a state of affairs approximately realised in Hicks's balance), and let them interact in any way. Let their accelerations at any instant be a_1 and a_2 respectively. These will be oppositely directed. Then the ratio of the masses is defined as being numerically equal to the inverse ratio of the accelerations, or

$$m_1/m_2 = -a_2/a_1,$$

the negative sign expressing the fact that the accelerations are opposed in direction. We may prove that the definition is valid by extending the experiments to a number of masses taken in pairs, and finding that the results are consistent. The unit of mass may now be fixed, and that of force defined in terms of it. Further, it may be pointed out that as consequences of the experimental verification of the validity of the above mode of definition, the principles of the equality of action and reaction, and that of the conservation of momentum, immediately follow.

From this point of view, therefore, we regard force as being a mass-acceleration rather than mass as the ratio of force to acceleration. The thermal analogy of Dr. Allen, if extended, suits the argument excellently. We do not obtain an *absolute* scale of temperature until we make it independent of any particular substance; neither are we able to measure force absolutely until *its* scale ceases to depend upon the behaviour of any special body under its action.

THE REVIEWER.

Altitude and Animal Development.

SOME time ago I found in the alluvium of a little Derbyshire stream a tubificid of a species and genus new to Britain. It was characterised by its large lymph corpuscles and its Pachydrilus-like form, on which account it was named *Meganympha pachydriloides*, Friend. The description showed that the animal possessed an average of forty-five segments, three or four forked setæ like Limnodrilus, a brain deeply lobed behind, spermathecæ pear-shaped or globular, and a penis-sheath, or large penial seta. While working out some species of Fridericia a few days ago, and turning to Bretscher (*Revue Suisse de Zoologie*, 19[…]) for some details, my attention was directed to his description of *Rhyacodrilus falciformis*, and it appeared evident that the Derbyshire worm was one with the Swiss.[1] But Bretscher states that the alpine forms have only thirty segments. Issel, de Ribaucourt, and Bretscher have recently given us many facts to show that annelids of the same species are very much smaller when found high up in the Alps than when found in the valleys. The foregoing seems to be an interesting confirmation of these statements.

But I find that other factors are at work. It is many years since Vejdovsky first described the little annelid known as Achæta, on account of the absence of setæ, but it is only within the last few months that specimens have been found in England. Southern found three different species in Ireland two years ago, and I have found the same number, though differing in kind, in England. Now Vejdovsky gives 15 mm. as the length of *Achæta bohemica*; but Southern says that though the Irish specimens agree with the Bohemian in other respects, they are but 5–6 mm. in length. In August I found *A. bohemica* Vej., in Kew Gardens, and the length agreed with the Irish forms. On November 7 I took the same species from a little grass plot in the heart of the city of Nottingham, and the specimens again measure 5–6 mm.

It seems easy to account for the difference in size in the case of Rhyacodrilus; but can any zoologist or biologist suggest an explanation of the difference between the Bohemian and British forms of Achæta?

HILDERIC FRIEND.

110 Wilmot Road, Swadlincote, Burton-on-Trent.

[1] Since writing the above I have discovered that Rhyacodrilus was described in 1904 by Ditlevsen as *Ilyodrilus filiformis*. He was familiar with Bretscher's work, but did not observe that the Danish tubificid had already been diagnosed.

RECENT THEORIES OF VOLCANIC ACTION.[1]

FIFTY years ago it appeared as though the volcanic problem had been completely and satisfactorily solved. Granted a cooling globe in which a solid crust covered heated matter, actually or potentially liquid, then the influx of sea-water through fissures in the crust seemed to account for all the phenomena observed during a volcanic outburst. Observations had then been almost wholly confined to the small group of Mediterranean volcanoes; but as our knowledge of volcanic action and terrestrial physics has grown with more continuous study over wider areas, these conclusions, as well as the premises on which they were based, have long since failed to satisfy students of geophysics.

One of the chief factors in bringing about this revolution in opinion has undoubtedly been the systematic study of the remarkable volcanoes of the Hawaiian islands, for which we are especially indebted to the geologists of the United States. In the great "pit-crater," or "sink," of Kilauea, always open to inspection, we find the explosive action and escape of gases reduced to a minimum, such "sinks" presenting the most marked contrast to the explosion-formed craters of Vesuvius and Stromboli (see Figs. 1 and 2). Equally striking is the difference between the great flat Hawaiian domes, rising above the ocean-floor to the height of the Himalayas, with slopes of from 1° to 4°, and the steep conical piles of Chimborazo and Cotopaxi. Another volcano of the same type as the Hawaiian, Matavanu, in the Samoan group, has been recently described by Dr. Tempest Anderson and other observers. In the study of the highly heated lavas of these volcanoes, an explanation has been found of the "slaggy" and "ropy" varieties of lava, as well as of the peculiar types known as "pillow-lavas" formed when they flow into the sea (see Fig. 3).

Photo.] [*E. Moses, Hilo.*

FIG. 1.—Panoramic photograph of Halemaumau (the open lake of lava in the crater of Kilauea) on January 13, 1910, with Mauna Loa in the background. The nearly circular lake was about 200 metres in diameter; its surface was estimated to be about 25 metres below the rim of the crater.

Photo.] [*E. Moses, Hilo.*

FIG. 2.—Panoramic photograph of Halemaumau on February 20, 1910. The lake level fallen about 30 metres below the surface of the "black ledge" of Kilauea in the foreground.

In addition to the new light thrown on volcanic action by the observations carried out in recent years on these Pacific volcanoes, there have been, during the last thirty years, three great outbursts of igneous activity, attended by phenomena of startling and unexpected character, which have served to awaken geophysicists to the fact that the old and simple theories formerly accepted stand in need of revision or replacement.

In 1883 the tremendous outburst of Krakatoa, in one of the great highways of the world's commerce, supplied opportunities for the study of the *explosive* type of volcanic action, which is so strikingly different from the *effusive* type of Hawaii and Samoa. Without any outflow of lava, fused matter was shot to the height of from sixteen to twenty-five miles into the atmosphere, the shocks producing air-waves that travelled two or three times round the globe. In this great uprush of gases, the molten materials were reduced to such a state of fine division that they were diffused through the whole of the atmosphere of the globe, giving rise to those wonderful sunset glows that will be so long remembered. In this great outburst, the hydrosphere was affected to a much less extent, and the lithosphere scarcely at all—for earthquake shocks, as distinct from air-concussions, were almost, if not entirely unfelt.

Five years later, in 1888, occurred the singular eruption of Bandaisan in northern Japan. In this case the sudden outburst of gases did not carry with

[1] "The Nature of Volcanic Action." By Reginald A. Daly. Proceedings of the American Academy of Arts and Sciences, vol. xlvii., No. 3, pp. 47–122, June, 1911. (Boston, Mass.)

it any molten materials, but was sufficiently violent to throw down one side of a volcano more than 6000 feet high, which had been long in the "Solfatarra

Photo.] [*T. Anderson.*

FIG. 3.—"Pillow Lava," formed by the molten material coming in contact with sea-water. The chilled surfaces form a scum which is stretched and distended by the still liquid material forced forward behind, into the great pillow-like masses shown above.

stage." The quantity of material thus displaced was calculated by Profs. Sekiya and Kikuchi, the commissioners appointed by the Japanese Government to investigate the phenomena, to be no less than 2782 millions of tons! European geologists had long been familiar with the fact that among the miniature volcanoes of the Eifel district there are examples in which scarcely any ejection of igneous matter has taken place, the vents being surrounded by fragments of slate and other underlying rocks; and the experiments of Daubrée and Sir Andrew Noble have shown that heated gases, under intense pressure, are capable of drilling holes through the hardest rocks. But in the case of Bandaisan, the "hurricane-blasts" hurled along the *débris* at the rate of forty-eight miles an hour, the hurtling masses of which were gradually reduced to the condition of sand, and covered an area of twenty-seven square miles. Although "steam" is said to have been seen rising to the height of 4200 feet above the "crater," the materials overwhelming the country were dry, except where they crossed lakes or rivers. But towards the end of the eruption scalding mud is said to have fallen and destroyed many lives; it is noteworthy, however, that a survivor declared that the gases in which he was enveloped were not of a poisonous character. From the direction in which the materials were thrown, there is some ground for the belief that the outrush of gas was not, as in Krakatoa, vertical in direction, but more or less oblique. The result of the eruption was to produce a great cavity which strikingly resembles the Val del Bove of Etna and the Caldera of Palma.

In 1902 there occurred, in the West-Indian islands of Martinique and St. Vincent, extraordinary outbursts of volcanic violence, which were carefully studied by English, French, and American geologists. In these cases the great destruction of life and property was caused by enormous volumes of superheated gas, charged with solid particles of all sizes, which rushed down the valleys leading from the mountain summits to the sea. These mixtures of gas and dust behaved like liquid torrents, and travelled at a rate of more than eighty miles an hour, sweeping everything before them. Their destructive action on living beings appears to have been in part due to the heated condition of the gas and in part to its suffocating character. In Martinique another very curious phenomenon was exhibited: the mass of molten rock consolidating in the vent of the volcano was gradually pushed up by forces from below until it formed a great "spine" which attained an elevation of nearly 1200 feet; but after many changes, due to both movement and disintegration, extending over more than a year, this "spine" finally disappeared (see Fig. 4).

It has generally been assumed by geologists that the chief component in the gas emanations—alike in Krakatoa, in Bandaisan, and in Martinique—was water gas; and this seemed to be indicated, not only by the vast clouds overhanging volcanic vents, but by the torrents of rain which, mingling with finely comminuted rock, gave rise to the "muddy lavas" often so much more destructive than the "fiery lavas" of active volcanoes. It is true that deposits of chlorides, sulphur, and other products around volcanic vents indicate the presence of various other gases in the uprising columns, but these have usually been regarded as quite subordinate to the high-pressure steam to which the most important action in volcanic eruptions has usually been attributed.

Photo.] [*E. O. Hovey*

FIG. 4.—The great "spine," composed of andesitic lava, which was forced up during the eruption of 1903 to the height of nearly 1200 feet above the crater-rim of Mont Pelée in Martinique.

It has long been known that lavas after their consolidation are found to contain, occluded in their

mass, gaseous matters which are given off when the rock is heated. This is especially true of lavas of a glassy character, which when fused have been shown to swell up into masses of pumice of many times the dimensions of the glass from which it is formed. M. Albert Brun, of Geneva, has collected and analysed the gases given off in such cases, and finds them to be nitrogen, ammonia, chlorine, hydrochloric acid, carbonic acid, and various hydrocarbons. Reasoning from these and other observations, he has been led to the conclusion that steam, instead of playing the most important part in volcanic eruptions, must be regarded, in many cases at least, as only an adventitious and accidental accompaniment of them. He has certainly shown grounds for the more thorough investigation of the nature and composition of these mixed gases, which, as recent studies have shown, play such an all-important part in volcanic outbursts.

But in addition to the more exact and systematic studies which have been made of the great volcanic eruptions in recent years, there is another class of researches which have supplied evidence of at least equal value concerning the nature and origin of these phenomena.

The study of rocks in thin sections under the microscope has shown that the two classes of rocks known as "plutonic" and "volcanic" respectively are essentially identical, and pass into one another by insensible gradations. Great areas of crystalline rocks ("batholites") and lake-like intrusions of similar materials ("laccolites"), lying in the midst of sedimentary and other rocks, were probably the roots of the volcanoes of previous periods in the earth's history. In these cooled reservoirs we may study the changes which have taken place in the magmas that have supplied the old volcanic vents, and—inverting the Lyellian principle—we may reason concerning the processes which must now be going on beneath existing volcanic vents from what we can prove to have taken place beneath those of former geological periods. Nor are there wanting examples of ancient volcanoes, dissected by the scalpel of denudation, which illustrate the intimate connection which exists between the plutonic and volcanic rock-masses.

The author of the memoir before us is well known to geologists by a number of valuable memoirs dealing with the evidence of changes which must have taken place in the great underground reservoirs of igneous rocks. These he has had the opportunities of investigating while engaged as a Canadian member of the International Boundary Surveys. More recently, he has had the opportunity of making a detailed investigation of the phenomena exhibited in the Hawaiian volcanoes. His outline of "a general working theory of vulcanism" is the result, as he tells us, "of the writer's studies in the Hawaiian Islands in 1909, but many of the chief conclusions are founded on his field-work in plutonic geology, as well as on the geology of many ancient volcanic formations."

That the hypotheses he now formulates are of a somewhat speculative character, and that many of his conclusions are more or less tentative, Mr. Daly fully admits; but that, nevertheless, his memoir is an important contribution towards the solution of a very difficult problem everyone will agree. He summarises his suggestions as a "substratum-injection hypothesis," believing that the surface phenomena can best be accounted for by abyssal injections of a deep-seated basaltic magma through an acid substratum of granitic or gneissic rocks everywhere underlying the sedimentary formations. But in elaborating his theory the author is led into a number of discussions of points of extreme interest and importance, and, even if his main conclusions are rejected, these subsidiary discussions retain their suggestiveness and value.

It is admitted by the author that the conditions leading to his "abyssal injections" "form a subject of great theoretical difficulty"; he apparently accepts the view that the high temperatures underground are due to the earth being a cooling globe, although he admits the influence of various chemical reactions in augmenting, locally, these high temperatures. The chief argument in favour of the view that the earth's interior is in a highly heated, if not molten, condition is, of course, derived from the fact that observations made in mines, tunnels, wells, and bore-holes everywhere indicate a progressive rise in temperature as we go downwards. Nevertheless, the most recent observations of underground temperatures have revealed such startling discrepancies between the results obtained in different areas—discrepancies that, it seems, are quite incapable of being explained by differences in the conductivity of rocks and similar causes—that the argument for a "molten globe" based on underground temperatures loses much of its force, and with it must go the estimates of the earth's age that have been based upon it. In these circumstances, the thoughts of geologists turn, not unnaturally, to the great revelation of radio-activity as a source of heat, for here may possibly be found the means of removing, to some extent at least, the "theoretical difficulties" which, the author admits, still beset the explanation of those deep-seated actions for which he argues.

J. W. J.

SPANISH OBSERVATIONS OF BROOKS'S COMET (1911*c*).

BROOKS'S comet has recently been a conspicuous object, and no doubt a great number of valuable observations have been made, both photographically and visually, at most of the observatories in the northern hemisphere.

Some very interesting records have recently been received from Señor F. Iniguez, the director of the Madrid Observatory, and not only do these include photographs of the comet itself, but an excellent spectrum accompanied by a list of the wave-lengths of the bands recorded.

The photograph showing the form of the comet was secured on September 28, with a 6-inch Grubb doublet, during an exposure of one and a quarter hours (9h. 15m. to 10h. 30m.), the comet then being of the second or third magnitude. This photograph is reproduced here (Fig. 1), the scale being 1 mm. to 5 minutes of arc. On this date the tail stretched to a distance of 15 degrees, and consisted of delicately fine interlacing filaments; the nucleus with its surrounding nebulosity measured 21 minutes in diameter. Spectroscopic observations were made visually with a slit spectroscope, and photographs were secured with the Grubb photographic equatorial, having an objective prism of 20 cm. aperture and 20° refracting angle. These have shown the spectrum to consist of seven images of the nucleus. The visible bands are the three situated at the red end of the spectrum, and these form three distinct spectral bands, while the sixth is composed of fine lines. The seventh appears double, although its components are not well defined and were measured as single.

The wave-lengths have been determined by Señor Iniguez from four plates taken on September 19, 20, and 26. The three visual monochromatic images of

the nucleus are λ 555, 514, and 472. The fourth band is made up of the lines λ 440, 434, and 432, and the wave-length of the fifth is λ 423. The sixth band he finds to be composed of the lines λ 410, 407, 405, 404, and 402, while 388 he gives as the wave-length of the seventh band. By using a prismatic camera, the spectrum of the comet's tail has also been secured, but because of its faintness only monochromatic images of the tail in the three visible bands were

FIG. 1.—Brooks's Comet as photographed on September 28 at the Madrid Observatory with an exposure of 1½ hours.

recorded. The whole length of the spectrum indicates the presence of a faint continuous spectrum. This spectrum was secured on the night of September 26 with an exposure of two hours (9h. to 11h. G.M.T.). Besides a paper print of this spectrum, a drawing with a scale of wave-lengths also accompanies the communication. This drawing is reproduced here (Fig. 2), but the violet has been placed on the left-hand side to conform with the general adopted procedure.

the chief carbon bands being strongly developed, it is very probable that the Madrid spectrum represents bands and lines of the same substances. No doubt in the near future spectrum observations, both photographic and visual, made at other institutions, will be soon forthcoming, so it will be interesting to see if the same explanation of the origin of the bands is corroborated.

W. J. S. LOCKYER.

CONFERENCE ON THE THEORY OF RADIATION.

A VERY successful meeting was held in Brussels from October 29 to November 4, to discuss the present position of the theories of radiation and of molecular theory in general. The following were present at the meeting:—Profs. H. A. Lorentz, Kamerlingh Onnes, W. Nernst, M. Planck, Rubens, Sommerfeld, W. Wien, Warburg, Brillouin, Mme. Curie, Langevin, Perrin, Poincaré, Einstein, Hasenöhrl, Martin Knusden, J. H. Jeans, and Rutherford, while Dr. Goldschmidt, of Brussels, Dr. de Broglie, of Paris, and Dr. Lindemann, of Berlin, acted as secretaries.

The inception of this "conseil scientifique" was due to Mr. Ernest Solvay, of Brussels, who very generously offered to defray the expenses of the conference and the cost of publication of the papers and discussions contributed at the meeting. The members were the guests of Mr. Solvay at the Hotel Metropole, and with the exception of one meeting at the Physiological Institute, founded by Mr. Solvay, the meetings took place in one of the reception-rooms of the hotel. The arrangements of the meeting were under the charge of Dr. Goldschmidt, who was indefatigable in looking after the comfort of the visitors. Prof. H. A. Lorentz was president of the "conseil scientifique," and the success of the meeting was due in large measure to his able management.

The following papers were read before the congress:—Sur l'application au rayonnement du théorème de l'équipartition de l'énergie, by Prof. H. A. Lorentz; a short communication in the form of a letter from Lord Rayleigh; the kinetic theory of specific heats, by Prof. J. H. Jeans; die Gesetze der Wärmestrahlung und die Hypothese der elementaren Wirkungsquanten, by Prof. Max Planck; die Bedeutung des Wirkungsquantums für unperiodische Molekularprozesse in der Physik, by Prof. Sommerfeld; zum gegenwärtigen Stande des Problems der spezifischen Wärme, by Prof. Einstein; Anwendung der

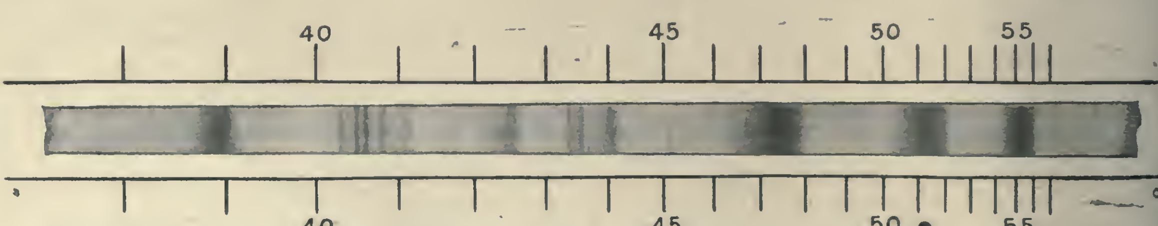


FIG. 2.—Spectrum of Brooks's Comet drawn from a photograph taken at the Madrid Observatory.

The writer has made a comparison of this spectrum with that which was taken of comet 1907*d* (Daniel) by Prof. Campbell. While the latter spectrum is on a very much larger scale and rich in detail, it is seen nevertheless that both are very closely identical when allowance is made for the smaller scale. As Daniel's comet was stated by Campbell to show no radiations other than those due to carbon or carbon compounds,

Quantentheorie auf eine Reihe physikalisch-chemische Probleme, by Prof. Nernst; les preuves de la Réalité Moléculaire, by Prof. Perrin; die kinetische Theorie der ideale Gase und die Versuchsresultate, by Prof. Knusden.

A vigorous discussion took place on each of these papers, an abstract of which will ultimately be published. Special interest was taken in the papers deal-

ing with the question of specific heats. Prof. Nernst gave an interesting account of the experiments upon the variation of specific heat with temperature down to low temperatures and of their explanation in terms of the "quantum" theory proposed by Prof. Einstein.

The meeting took place under unusually pleasant social conditions, for all the members were staying at the same hotel and dined together. The interchange of views on many problems of modern physics was a feature of the occasion, and led to a much clearer understanding of the points at issue.

At the close of the meetings, Mr. Solvay invited the conference to meet again in Brussels in 1913.

E. RUTHERFORD.

SIR SAMUEL WILKS, BART., F.R.S.

SIR SAMUEL WILKS, at the time of his death, on November 8, the senior fellow of the Royal College of Physicians of London, was born at Camberwell on June 2, 1824. He was the second son of Joseph Barber Wilks, treasurer to the East India Company, who himself had many ancestors in the service of that company. He was educated at Aldenham. In 1840 he was apprenticed to a family doctor at Camberwell, Mr. Richard Prior, whose widow he subsequently married. He began to attend lectures at Guy's Hospital in 1841, and took the M.D. London in 1850. He earned many distinctions at the University. In 1856 he became a fellow of the College of Physicians, and assistant physician to Guy's Hospital, in 1867 full physician; in 1870 he obtained his F.R.S., and in 1897 his baronetcy. He was president of the Royal College of Physicians from 1896 to 1899, and he was a governor of Guy's Hospital.

Wilks began work at a period when most doctors were satisfied with vague words that meant little; hence his desire to know the causes of things was at that time remarkable, and led him to be the first to make systematic post-mortem examinations whenever he could. When he gave up his work in the post-mortem room, he had made more post-mortem examinations than anyone alive except Virchow. In the course of these he found that syphilis could affect internal organs. As now we know that several internal diseases are due to it, this was a most important discovery. The original paper, entitled "On the Syphilitic Affections of Internal Organs," was published in the "Guy's Hospital Reports" for 1863. Of it in later years Wilks wrote, "I regard this as the most noteworthy and original article it has been my good fortune to write."

He was a great observer, and was the first to point out that excess of alcohol causes paralysis of the limbs, and that atrophic lines may form on the skin apart from stretching of it; he described and named the condition of the knuckles called "verruca necrogenica," and under the name of arterial pyæmia he described what is now known as malignant endocarditis; also he did much to establish firmly that Bright's disease, Addison's disease, and Hodgkin's disease were distinct entities. The last he discovered independently, but found that Hodgkin had given an account of some examples of it, and accordingly Wilks gave the name Hodgkin's disease to it.

All Wilks's investigations were done at Guy's Hospital, and he greatly added to the reputation of its medical school. His strong personality and his enthusiasm for the advancement of medical knowledge made him much beloved by students, and by his influence many were stimulated to take an interest in their work as an intellectual pursuit. He was always the champion of investigators, and was one of the most energetic in forming the Society for the Advancement of Medicine by Research. His mind was extraordinarily active even when well advanced in years. He did not retire until he was seventy-seven years of age, and then, when he went to live at Hampstead, he was, at the age of more than eighty, president of the Hampstead Scientific Society, and read papers before it.

His "Pathological Anatomy," first published in 1869, has gone through three editions. It has become one of the medical classics, and is still the best book on the subjects of which it treats. It has been well said that if you think you have discovered a new fact in morbid anatomy, you will find it was observed by Wilks and is mentioned in his book. Students were so much attracted by the matter of his lectures that at their request they were published, and form his two other books, "Diseases of the Nervous System" and "Specific Fevers and Diseases of the Chest."

W. H. W.

MR. JOHN BROWN, F.R.S.

THE death of Mr. John Brown, which, as announced in last week's issue, occurred at Belfast on November 1, removes one who was a scientific amateur in the best sense of that term, and whose enthusiasm bore fruit in much solid work in the department of physics in which he was specially interested.

Born in 1850, the son of a prominent linen merchant, in the north of Ireland, Mr. Brown, after a very short experience of business life, retired from the firm which bears his father's name in order to devote himself entirely to the scientific and engineering pursuits for which his bent had been clearly shown from boyhood. He soon became absorbed in electrical matters, particularly in the question of Volta contact electricity, about which then and since so much controversy has been carried on. His first paper on the subject was published in *The Philosophical Magazine* in 1878, and was followed by a series of others in which he detailed the results of his experiments and lent important support to the chemical theory of these phenomena. The work was done largely by means of home-made apparatus, and gave evidence of experimental ingenuity and carefulness of a high order. He maintained that the effects were due to films of condensed vapour or gas on the surface of the metals, and regarded the pair of metals in contact as equivalent to a voltaic cell, divided in the electrolyte, and having the amount of electrolyte reduced until only an invisible film remains on each plate. In support of this theory he tried the effect of surrounding the metals by different gases, and obtained variations in the value of the potential difference, the proper interpretation of which was a matter of some controversy.

Mr. Brown was elected a fellow of the Royal Society in 1902, and in the following year he published what proved to be his last contribution to the voltaic question. In this he claimed to have got rid of the gaseous films by heating the plates to a high temperature in a bath of petroleum, when the difference of potential was found to disappear. Before his death he had planned to repeat this crucial experiment with additional precautions during the present winter.

His other publications of pure scientific interest were in connection with the allied question of electrolytic conduction. On this he took up a position strongly hostile to the modern developments of the dissociation hypothesis.

Mr. Brown was much interested in mechanical and engineering matters, especially in connection with motor engineering, on which he did some pioneering

work. This led him to study the question of road-making and road-testing, and he devised an ingenious instrument, called the viagraph, which gives a trace of the contour of the road-surface and a numerical value for its "bumpiness."

Mr. Brown will be much missed in Belfast, where he did a great deal to kindle and keep alive scientific interests in the community, and where his personality and ability won him much influence and popularity.

W. B. M.

THE SOLAR PHYSICS OBSERVATORY.

THE *Cambridge University Reporter* gives an account of the action taken by the Council of the Senate on this subject. None of the scientific questions we referred to in the article in last week's NATURE are touched upon, including the all-important question of the site, and the dismissal of the staff which for the last thirty years has done work which has received world-wide approval, on a programme which has been followed in the newer institutions.

One of the points insisted upon is how the University is to find the 600*l.* a year, representing a capital sum of 15,000*l.* or 30,000*l.*, according as we reckon the interest at 4 or 2 per cent., which the Treasury demands in return for the capital sum of 5500*l.* to be inserted in the estimates for the new installation.

We confess we look with dismay upon the proposal. We trust the Senate will well consider it in all its bearings. It is not the fault of the Senate that Cambridge can never be a fit site for an observatory occupied in the work demanded by modern physical inquiries, but it will be its fault if it acts as a cat's-paw of the Treasury in aiding the detachment of national scientific work from the direct control of a Government spending department with a voice in the Cabinet; in agreeing to administer the needs of a rapidly growing branch of science for a fixed sum based only on the present needs; and in endorsing the view that its future alumni when appointed directors of national observatories are sufficiently remunerated by a stipend of 200*l.* a year.

NOTES.

IN reply to an inquiry as to the award of the Nobel prizes, Prof. Svante Arrhenius has kindly sent us the following information:—(1) *Prize for medicine:* awarded on October 21, the birthday of Dr. Alfr. Nobel, by the Carolinian Institute (faculty of medicine) in Stockholm to Dr. Allvar Gullstrand (born 1862), professor of ophthalmology in the University of Upsala, Sweden, for his investigations in physiological optics. (2) *Prize for physics:* awarded on November 7 by the Royal Academy of Sciences, Stockholm, to Dr. Willy Wien (born 1864), professor of physics at the University of Würzburg, Bavaria, for his discoveries regarding the laws of radiation. (3) *Prize for chemistry:* awarded on November 7 by the Royal Academy of Sciences, Stockholm, to Mme. Marie Curie (born 1867), professor of physics in the University of Paris (Sorbonne), for her discoveries of the chemical elements radium and polonium, and her investigations regarding their chemical properties. Mme. Curie received, together with her husband, the half of the Nobel prize for physics in 1903 for their investigations regarding the Becquerel rays. (4) *Prize for literature:* awarded on November 9 by the Royal Swedish Academy of Literature, Stockholm, to Maurice Maeterlinck (born 1862). The prize for work in the cause of peace will probably not be awarded before December 10, the day of Dr. A. Nobel's death, by the Storthing (Parliament) in Christiania, Norway.

WE notice with regret the announcement that Dr. R. D. Roberts, Registrar of the Board for the Extension of University Teaching, University of London, and secretary and lecturer to the Gilchrist Educational Trust, died suddenly on November 14, at sixty years of age. Dr. Roberts was widely known and esteemed, and his death will come as a great shock to all those who were brought into association with him. An obituary notice in *The Times* gives the following particulars of his career. He was educated at University College, London, and Clare College, Cambridge, of which he was a foundation scholar and later a fellow. He was also a fellow of University College. His university career was a brilliant one. At University College, where he took the D.Sc. degree in 1878, he carried off the university scholarship in geology, and at Cambridge he took a first class in the natural sciences tripos. In 1879 Dr. Roberts was appointed university lecturer in geology at Cambridge, having previously been an examiner in that subject. Six years later he became secretary to the London Society for the Extension of University Teaching, and afterwards secretary for lectures of the Local Examinations and Lectures Syndicate, Cambridge, before taking up his work at the University of London. The fruits of his wide experience were gathered in his book "Eighteen Years of University Extension," and he also wrote "An Introduction to Modern Geology." As secretary to the Congress of the Universities of the Empire, which is to be held in London next year, his work of organisation has been of great value.

THE Royal Scottish Geographical Society has awarded the gold medal of the society to Mr. J. Y. Buchanan, F.R.S., for his distinguished services to geography, especially in connection with oceanographical research.

MR. R. J. GODLEE has been elected president of the Royal College of Surgeons of England, in succession to Sir Henry Butlin, Bart., who has resigned that office on account of ill-health.

THE Paris correspondent of *The Times* reports that the French Government has conferred upon Halil Bey, director of the Imperial Museum at Constantinople, the rank of Commander in the Legion of Honour, and the rank of Officer upon Prof. Lowell, president of Harvard University.

MR. ARTHUR COOPER, of Middlesbrough, has been elected to succeed the Duke of Devonshire in the presidency of the Iron and Steel Institute next May. Mr. Cooper was awarded the Bessemer gold medal of the institute in 1892 for his services to the metallurgy of iron and steel.

THE Berlin correspondent of *The Times* announces the death, at seventy-four years of age, of Dr. Bernhard Fränkel, who enjoyed a European reputation in his own subject of laryngology, both as a practitioner in Berlin and as the author of many scientific works, and the inventor of improved methods and instruments.

A REUTER message from New York states that Mr. Andrew Carnegie has given the Carnegie Corporation, which was organised on November 10, 5,000,000*l.* in gold bonds of the Steel Corporation. The corporation has been founded for the purpose of the advancement and diffusion of knowledge and understanding in the United States, for the formation of a hero fund, and other purposes.

THE Jean Reynaud prize of ten thousand francs, which is awarded by the Paris Academy of Sciences every five years for the work of an eminent savant, has been awarded this year to Prof. Emile Picard, professor at the Sorbonne and at the Ecole Centrale. Previous awards of the prize have been to MM. Lippmann, Henri Poincaré, and Pierre Curie.

The De Morgan medal of the London Mathematical Society has been awarded to Prof. Horace Lamb, F.R.S., for his researches in mathematical physics. At the annual general meeting of the society, held on November 9, the following were elected to be the council and officers for the session 1911–12:—*President*, Dr. H. F. Baker; *vice-presidents*, Mr. J. E. Campbell and Prof. A. E. H. Love; *treasurer*, Prof. Sir J. Larmor; *secretaries*, Mr. J. H. Grace and Dr. T. J. I'A. Bromwich; *other members of the council*, Mr. G. T. Bennett, Prof. W. Burnside, Mr. E. Cunningham, Mr. A. L. Dixon, Dr. L. N. G. Filon, Mr. J. H. Jeans, Mr. J. E. Littlewood, Prof. H. M. Macdonald, Major P. A. MacMahon, and Mr. A. E. Western.

The disease known as "infantile paralysis" has recently been added to the list of notifiable infectious diseases in London by an order under the Public Health Act. This disease, known medically as acute anterior polio-myelitis, was referred to in our "Notes" columns of October 12 (p. 494), and, though probably not existing in London at the present time, was epidemic in the Plymouth district this summer. In this epidemic, an account of which was given by Dr. Bertram Soltau in *The British Medical Journal* of November 4, 154 cases were notified between May and September, of which 34 died, a case mortality of 22 per cent. The disease may therefore be an important one, and sanitary authorities will do well to be on the look-out for it and to exercise the option they possess of making it notifiable.

The death is announced, at the age of eighty-four, of Mr. Daniel F. Drawbaugh, a veteran American inventor. He was a self-taught man, and worked in his early years as a clockmaker in his native village in Pennsylvania. He became an enthusiast on the subject of physics, and made electrical apparatus a special study. In 1860 he devised an instrument for the electrical transmission of speech, and in 1870 claimed to have invented a magneto-transmitter similar to Bell's. In 1881 his claim to be the inventor of the telephone was adversely decided in the courts, his interests being represented by the People's Telephone Co., against which the Bell Co. brought a suit. Mr. Drawbaugh made only a moderate fortune with his inventions, which included an interchangeable telephone and telegraph apparatus, the collapsible lunch-box, the first nail-making machine, higher grade electrical grain-weighing devices, and various pneumatic tools.

The following announcements have just been made by the Meteorological Office:—Mr. G. I. Taylor, fellow of Trinity College, Cambridge, Smith's prizeman, 1910, has been appointed Schuster reader in dynamical meteorology for three years from January 1, 1912; Mr. L. Southerns, of Emmanuel College, Cambridge, has been appointed special assistant at Eskdale Observatory; Mr. G. Dobson, research student of Gonville and Caius College, Cambridge, has been appointed graduate assistant for research in atmospheric electricity for one year from October 1, 1911. Dr. Arthur Schuster, F.R.S., has presented to the Eskdale Observatory an instrument, made in St. Petersburg from designs by Prince Boris Galitzin, for the registration of the vertical component of seismic movements. Dr. Schuster had previously presented corresponding instruments for registering the horizontal component, so that all three components are now the subject of continuous registration.

The death is announced, in his seventy-first year, of Mr. Holt S. Hallett, who was widely known as an engineer and traveller. From 1860 to 1868 Mr. Hallett assisted in the construction of railways in Lancashire and Cheshire. In 1868 he entered the Indian Public Works Department, and was employed in the construction of the oldest line in Burma, that from Rangoon to Prome, which was completed in 1877. He retired from the public service in 1880, and was soon engaged in the exploration of the little known country between Moulmein and Kiang Hsen on the Mekong for a railway route into Siam, and made a survey for a branch line to Bangkok. He explored about 2500 miles of country, and discovered the sources of the Menam. The general results of his explorations were laid before the Royal Geographical Society in 1883, and an account of his work is to be found in his "A Thousand Miles on an Elephant." He revisited Siam, Burma, and India in 1885, and at the request of the Foreign Office and the War Office sent in a report, with maps, bearing on the political state of affairs in Indo-China. In 1887 Mr. Hallett received the silver medal of the Socity of Arts for a paper on new markets and the extension of railways of India and Burma.

A point which is now agitating the aëronautical industrial world is one that is down for discussion on the agenda of the International Aëronautical Federation, which meets at Turin on November 25. It is, briefly, that it should be made compulsory for aëroplane manufacturers to submit a specimen machine of each type made by them to the representatives of the International Aëronautical Federation, *i.e.* the Aëro Club, in their respective countries in order to receive a certificate of soundness of construction. It will be obvious at once that at the present time such a rule is absurd, for the chief reason that, for instance, in this country only the manufacturers themselves are capable of passing an expert opinion on the merits of any machine submitted. Furthermore, if carried out, it would shift responsibility from the manufacturers to the aëro clubs, which are privately organised bodies, and it would tend to confine the manufacture of machines to certain standard types and close the way to originality and progress. Manufacturers are already up in arms in this country against this extraordinary measure, which, it may be stated, has its origin in France, and it is to be hoped that the delegates of the Royal Aëro Club will receive instructions to oppose it to the utmost. In such attitude they will, no doubt, have the support not only of the club they represent, but also of the German and Italian organisations.

At the meeting of the Concrete Institute held on November 9, Sir Henry Tanner, C.B., delivered his presidential address. During the course of his remarks he said that the membership of the institute is now about 875, and that during the eighteen months ending in June last the net gain was twenty-one. There is no institution, he pointed out, concerned particularly with structural engineering; and the committee of the institute has been empowered to take steps to foster structural engineering, and thus in future the Concrete Institute will be an institution of structural engineers as well. Sir Henry Tanner went on to say that the Institution of Civil Engineers has taken up the subject of reinforced concrete, and a considerable sum of money has been devoted to experiments which are in process of being carried out. There is no doubt, he said, that experiments are needed in this country to obtain a consistent and complete series based on materials to be obtained here and mixed and tested under similar conditions. At the present time we have to rely on experiments in America, Germany, and France with cement of varying character, and it would be of the greatest advantage if these could be repeated in some cases at intervals, the improvement in strength being so great for

some years. Later in the address he referred to the committee appointed by the Board of Education to inquire into the question of economy in building, and as to whether buildings of a more temporary nature could not be brought into use. Reinforced concrete came in for its share of the discussion by the committee; but the estimates of cost varied largely, from 33 per cent. less to 10 per cent. more than for ordinary building. No difference of locality will account for these variations. Witnesses having a more intimate knowledge of the cost of such buildings might have been called. It is little good encouraging specific proposals for the use of novel materials while local by-laws make no provision proper to the use of reinforced concrete. In order, however, to remove this difficulty, it has been suggested that legislation should be promoted to exempt school buildings, the plans of which had been approved by the Board of Education, from the operation of local building by-laws.

A PAPER on a novel and important subject appears in *The Naturalist* for November. The writer, the Rev. Hilderic Friend, has brought together some interesting facts relating to *Octolasium gracile*, Oerley, which is usually found very sparsely, but at Sutton Broad is the dominant Allolobophora; and *Aporrectodea similis*, Friend, a species which is at present known only from the Kew Gardens. An account of the species of Fridericia found at the Eel Hut, where the River Ant enters the Barton Broad, is also very suggestive. Out of twenty-four Euchytræids, belonging to six different species, twenty-two were Fridericias, belonging to five species, of which two have not been observed hitherto in England. One question to be solved is, Does each species do the same work as all the rest, or does one prepare the way for the others?

MR. O. A. RHOUSOPOULOS contributes to vol. ii., No. 5, of *The Museums Journal* an important article on the methods of cleaning and preserving antiquities. The most frequently recurring objects which need preservation are those of copper or copper alloys. For these various methods are considered: soaking in distilled water; saturation with paraffin; reduction treatment by heating in a current of hydrogen, by an electric current in a bath of potassium cyanide or caustic soda. Some of the above methods, which in their present perfection leave little to be desired, may be applied to gold, silver, and their alloys; but the use of a solution of potassium cyanide yields better and more rapid results. Wood and fibres are soaked with antiseptic solutions, and finally receive a coating of celluloid varnish. The article ends with many valuable suggestions for the treatment of objects of iron, lecythi and other coloured earthenware, marble, and porous limestone. The instructions throughout are practical and detailed, and the article may be commended to the attention of all curators of museums.

THE Sutton Broad Biological Laboratory, started in 1902 by Sir Eustace Gurney, and, we believe, still the only fresh-water biological laboratory in this country, has so far well justified its existence. In the current number of the Transactions of the Norfolk and Norwich Naturalists' Society are two papers, emanating from this laboratory, which are of especial interest with reference to the much debated question as to what constitutes "tide" on the Norfolk Broads. For several years past observations, made with a portable recording tide-gauge, have been kept at the laboratory by Mr. Robert Gurney; and in the publication referred to these have been incorporated into a paper, well illustrated with charts. In the same journal Mr. A. G. Innes contributes a paper on the distribution of salt in the River Bure and its tributaries; and, taken together, these two papers are a valuable addition to our knowledge on the subject.

THE report of the Northumberland Sea Fisheries Committee on the scientific investigations conducted under its auspices during the year 1910 and up to June 15, 1911, has now appeared under the editorship of Prof. Alexander Meek, of the Armstrong College, Newcastle-upon-Tyne. It includes some interesting observations on mesmerising lobsters and other crustaceans. It is known that a lobster may be put into a comatose condition by rubbing it along the back of the carapace. The usual way is to hold the lobster head down, with the claws arranged so as to form a support with the rostrum, and to stroke it rapidly with the tips of the fingers. In about a minute the lobster succumbs, and remains without movement in this position for a variable period. With a view to see whether the reversed position, as determining the blood to the head, was essential, a lobster was treated in the horizontal attitude, and so successfully that it remained without movement for three hours. A Norway lobster subjected to a similar treatment was quiescent for fifty-five minutes. A lobster can be put to sleep on its back. The crab goes to sleep usually in the tucked-up condition—and may be left in the natural position or on its back. They all recover when disturbed; but the recovery of the lobster appears to be quicker if the undersurface of the cephalo-thorax is disturbed. Placed in sea water lobsters recover immediately, but in one such case a crab took ten minutes to come round completely. During the sleep the scaphognathite is in action all the time.

MR. E. J. SHEPPARD contributes to the Journal of the Royal Microscopical Society for October observations on the reappearance of the nucleolus in mitosis. He finds that, in the dividing cells of hyacinth and other plants, there appear, at the close of the diaster stage, one or more loops of chromatin in each future daughter nucleus. At a little later stage, when the division of the cell is well marked, the nucleolus makes its appearance, apparently by a streaming, into the area enclosed by the loop, of material from the chromatin. Mr. Sheppard has not been able to trace corresponding changes in the loop-areas of animal cells. He regards the nucleolus as inciting or stimulating the process of mitosis.

DEALING with the subject of alpine gardens in a lecture published in the Journal of the Royal Horticultural Society (vol. xxxvii., part i.), the Swiss botanist M. H. Correvon states that the English climate suits alpine plants better than the continental climate in Switzerland, except such tufted dwarf plants as the species of Eritrichium and Androsace. This statement follows upon a description of the chief features observed in the gardens at Friar Park, Leonardslee, and other notable alpine gardens in Great Britain. Reference is made to the interesting Swiss garden of the Linnaea at Bourg-St.-Pierre in the Valais, where the choicest developments are the masses of *Papaver alpinum*, superb growths of *Eryngium alpinum*, *Heuchera sanguinea*, and *Epilobium latifolium* and abundance of edelweiss. M. Correvon claims for his countrymen the superiority in plant culture on walls, where saxifrages, androsaces, campanulas, and other suitable plants can be induced to make a brilliant show; he also mentions that the walls bordering the mountain railways from Territet to Glyon and Vevey to Pèlerin have been so planted.

IN *The Agricultural Journal of India*, part iii., Mr. Keatinge continues his account of the rural economy of the Bombay Deccan, dealing specially with the livestock.

Great improvements seem to be possible. Ponies, which once had a high reputation, are now poor; goats and sheep do not bring in anything like the profit they might; whilst the cattle also appear to have deteriorated during the past fifty years. These changes are largely attributed to the large increase in cultivated ground and the consequent reduction in the grazing area. An interesting account of grape-growing round Peshawar, accompanied by some good illustrations, is given by Mr. Robertson-Brown.

THE cultivation of cacao is a highly important industry in Trinidad, where also the great bulk of the planters are peasant proprietors. Hence the problem before the staff of the Department of Agriculture is of a dual nature; new methods have to be worked out for improving yields and coping with pests, and these methods have to be brought to the notice of the grower. In a batch of circulars recently to hand instructions are given in the methods of cultivation calculated best to suit a small proprietor. The entomological and mycological notes by Messrs. Guppy and Urich will be found of more general interest. It is stated that leaf-eating beetles were very common last year, particularly *Neobrotica colaspis*; pod-hunters (*Horiola arcuata*) have also been locally numerous.

IN Bulletin No. 7 of the Commonwealth Bureau of Meteorology the climate of the proposed Federal Capital Territory at Yass-Canberra, in New South Wales, is dealt with. Besides a few preliminary paragraphs, the whole Bulletin is devoted to tables of the mean monthly values for twelve stations, and the average maximum and mean rainfall for a considerably larger number. Rainfall and temperature data are also shown for an area of about eight square degrees on a map, which might conveniently have been on a smaller scale, the isotherms being drawn in by interpolation from the twelve observing stations and by employing corrections of 1° F. for each 300 feet of altitude and each degree of latitude. No. 8 Bulletin of the same Bureau deals with the physiography of the same area. Mr. G. Taylor treats by the modern explanatory method the land-forms for a radius of about 20 miles round Canberra. Various parts are first described in their present condition, after which the past development of the region is worked out. An ancient peneplain was uplifted for some 800 feet and then maturely eroded, after which a period of unrest set in, during which blocks have been tilted, and the drainage system thereby considerably modified, numerous cases of river-capture occurring. The report is illustrated by sketch-maps and diagrams, and gives a good idea of the area, which would have been improved by a short general description of the main features of this part of New South Wales.

IN Heft No. 9 of the *Mitteilungen der k.k. Geographischen Gesellschaft* of Vienna an account is given of the May cruise of the surveying ship *Najade*. Soundings were taken on the line Brindisi-Durazzo, and the considerable depths which observations in 1877 had indicated were not borne out. In lat. 41° 15′ N. and long. 18° 15′ previous soundings of 1500 and 1600 metres are replaced by more correct values of from 1000 to 1100 metres. The greatest depth of the Adriatic, hitherto given as 1645 metres, is now to be taken as 1132 metres somewhat to the north of the point previously indicated in the basin between Novi and Cattaro or Ragusa. A brief summary of the biological work is also given.

IN the November number of *The Geographical Journal* there appears a map of Africa on which are shown in different grades of colour the portions systematically surveyed, those mapped by good route traverses, and the areas which are but roughly mapped or known only by report. While the second class covers a large area, systematic survey is limited to frontier lines and to areas in Algeria, Egypt, Uganda, South Africa, and a few other points. There still remain vast areas both for exploration in its true sense and for systematic study, and if a corresponding map had been prepared to show our knowledge of the continent from other points of view than its topography the scope for investigation would be seen to be even wider than appears from the present map.

IN the *Zeitschrift der Gesellschaft für Erdkunde* (No. 7) Prof. K. Kretschner completes his survey of the manuscript maps of the National Library at Paris. These date mostly from the sixteenth and seventeenth centuries, and are of the class known as compass charts or portolan maps. While some bear the name of the author, many are anonymous; and maps of both classes are described in the present article, which deals only with those hitherto unknown or which have been very imperfectly treated. The investigation was undertaken in order to improve our knowledge of this portion of early cartography by examining, so far as possible, all the maps preserved in different countries or cities, as has been very completely done for Italy and largely carried out in Germany.

THE October number of *Le Radium* contains a short note by Madame Curie on the variation with time of the activity of some radio-active substances. The measurements have extended over several years, and the results given have been standardised by the use of the piezo-electric charge on quartz. The black oxide of uranium tested for four years in an ionisation chamber in which the whole of the α radiation was absorbed showed no change. Actinium showed a decrease of activity of about 10 per cent. in three years; and Madame Curie assigns to it a mean life of thirty years. Radium, purified from emanation and from traces of radium D, E, and F, was tested by means of its β and γ radiation, and found to increase in activity 5 per cent. in two years. Madame Curie attributes this increase to the formation of radium E. Radium D, purified from radium E and F, appears to have a life of about twenty-five years. The measurements are being continued so that the changes observed in succeeding years may be determined.

IN the July number of the Tokio *Sugaku-Buturigakkwai Kizi* Mr. S. Nakamura describes a panoramic camera by means of which the whole horizon (360°) can be photographed on a stationary film, which is bent into a cylinder and suitably supported inside the camera wall. In order to get the image on the film it is necessary to have two reflecting surfaces parallel to each other and inclined at an angle of 45° with the vertical axis of the camera, the one above the camera to receive the light from the view, and the other within to receive it from the upper mirror and reflect it to the film. The lens may be horizontally in front of either of the reflectors or vertically between them, and in making an exposure the complete optical system revolves on its vertical axis. The chief optical condition necessary in all such apparatus is that the second nodal point of the objective must be at the centre of rotation, and in this case in the centre of the camera. With ordinary photographic objectives, in which the nodal points lie within the objective itself, it is difficult, if not impossible, to fulfil this condition in these circumstances. The author therefore uses a lens which consists of a negative as well as a positive combination, as in telephotographic lenses, so that the nodal points are thrown well outside the objective; it is then only a matter of construction to fulfil every necessary

condition. The camera may be compared to a large pill-box, but the lid, which carries the rotating optical system, is as deep as the box within which the film is held by two rings, one notched or marked to indicate on the photograph the azimuths of the objects on the picture. A right-angled prism is preferred for the upper reflector, and the rotation is done by hand by means of a toothed wheel and endless screw.

THE first annual report of the Road Board, established under the powers of the Finance Act of 1909, has been recently published. This Board was formed for the purpose of improving the main roads of this country, rendered necessary by the general adoption of motor vehicles. The funds required for the purposes of the Board are derived from the duties imposed on motor spirit and motor licences levied under the powers of the Act. The applications for aid from local authorities amounted to 7,870,459*l*. Up to the end of June the Board had been able to allocate out of the money placed at its disposal for the first year, 1,161,000*l*., the sum of 270,824*l*. This sum was to be applied to the improvement of main roads and important connecting roads passing through rural areas; also to the improvement of the surface of the roads and the alleviation of the nuisance arising from mud and dust due to motor traffic, and to bringing the road surfaces up to such a standard of construction that the cost of future upkeep to the local authorities may be brought within the means available from local sources. For this purpose the Board has sanctioned the use of bituminous binding material, and has issued general directions and specifications relating to the treatment of road surfaces. The Board has also taken steps to establish at the National Physical Laboratory at Teddington a laboratory for testing the value of different kinds of stone used for road repairs. This work is to be under the direction of the Geological Survey.

A CATALOGUE of gardening books and literature, comprising many early works, has been issued by Messrs. John Wheldon and Co., Great Queen Street, London. The items are arranged under the sections of flower, fruit, kitchen and landscape gardening, trees, conservatory and general treatises.

IN the notice of those volumes of "The Home University Library" published in NATURE of November 9, it was stated that "ten volumes will be issued each year." The publishers, Messrs. Williams and Norgate, ask us to say that the plan of publication is to publish ten volumes in each set at intervals of three or four months. Since April last thirty volumes have been issued, and at least one hundred are planned.

Forthcoming Scientific Books.—In the "Fauna of British India" Series, Canon W. W. Fowler's volume on the Cicindelidæ and Paussidæ, with a general introduction to the Coleoptera, and Mr. E. Brunetti's work on the Nemocera (excluding the Chironomidæ and the Culicidæ), are in the press. The remaining volumes which the editor, Mr. A. E. Shipley, with the assistance of Mr. Guy A. K. Marshall, and with the sanction of the Secretary of State for India, has arranged for in this series are:—volumes on the Orthoptera (Acridiidæ and Locustidæ), by Mr. W. F. Kirby; on butterflies (Lycænidæ and Hesperiidæ), by Mr. H. H. Druce; on the Curculionidæ, by Mr. G. A. K. Marshall; on the Ichneumonidæ, by Mr. Claude Morley; on the longicorn beetles, by Mr. C. J. Gahan; on the Blattidæ, by Mr. R. Shelford; on the Helicidæ, by Lieut.-Colonel H. H. Godwin-Austen; on the Ixodidæ and Argasidæ, by Mr. C. Warburton; on leeches, by Mr. W. A. Harding; on the Meloidæ, by Prof. Creighton Wellman; on the brachyurous Crustacea, by Lieut.-Colonel A. Alcock; and on the Unionidæ, by Mr. H. B. Preston.—Mr. Edward Stanford, official agent for the large-scale Ordnance maps, announces the publication of the first 165 sheets of a new issue on the scale of 50 inches to a mile (1 : 1250). Hitherto, apart from the town plans, the largest scale on which urban districts have been obtainable has been the well-known 25 inches to a mile, and the new issue is based on an enlargement of that map. The larger scale map has been specially prepared for use primarily in connection with land valuation, and the area covered by each sheet is one quarter of that of a 25-inch sheet.—The eighth edition of Fream's "Elements of Agriculture" is to be published by Mr. John Murray. The work of editing has been entrusted to Prof. J. R. Ainsworth Davis, of the Royal Agricultural College, Cirencester, who has considerably extended the scope of the book and brought it up to date.

OUR ASTRONOMICAL COLUMN.

PLANET MT.—The new and interesting minor planet discovered by Dr. Palisa on October 3 has, apparently, been lost again. It will be remembered that Dr. Palisa made observations on October 3 and 4, and Herr Pechüle on the latter date; but bad skies interfered and further observations were prevented. Then the Greenwich observers took a plate on October 25, with the Franklin-Adams camera, which showed apparent images in the supposed position of the planet. However, good plates taken the next night did not confirm this, and there is little doubt that the supposed images are spurious. This is most disappointing, for, as Dr. Crommelin points out in No. 441 of *The Observatory*, the object promised to be of extraordinary interest. The present known data are insufficient for a determination of the orbit, but the observations could be satisfied by assuming an orbit having about the same perihelion distance as Eros, with a slightly greater eccentricity. To explain its apparent disappearance, Dr. Crommelin suggests that, like Eros at some oppositions, this object may be rapidly variable in apparent brightness. Its motion showed it to be very near to the earth, and there is no need to suppose its diameter to be greater than a mile or two. Such small bodies need not be spherical; in fact, they might be discoidal, and would, therefore, suffer considerable changes of apparent brightness. The suggestion that Dr. Palisa's object might be a non-nebulous comet, such as Kopff's, moving in a parabolic orbit, is discounted by its planetary aspect and by the fact that an ellipse would fit the observations.

MARS.—Writing from the Sétif Observatory on November 4, M. Jarry-Desloges announces the appearance of seven fissures, towards M. Acidalium, in the north polar cap of Mars, and states that a bright area was seen on Nerigos.

From the Massegros Observatory, on October 31, it is reported that Juventæ Fons was easily visible, and that Coprates was dull and appeared bifurcated near L. Tithonius; three "lakes" were seen on Coprates, and several small ones on the site of Araxes. The south polar spot is said to be very luminous (*Astronomische Nachrichten*, No. 4534).

EPHEMERIDES FOR VARIOUS COMETS.—Nos. 4533–4 of the *Astronomische Nachrichten* contain ephemerides for Borrelly's (1911*e*), Brooks's (1911*c*), Quénisset's (1911*f*), and Beljawsky's (1911*g*) comets. Borrelly's comet is now just below τ^3 and τ^4 Eridani, and is moving northward at a little more than half a degree per day; it is of about magnitude 13·0. Brooks's comet is now travelling southward through Virgo at nearly a degree a day, and will be near γ Hydræ on November 21; its calculated magnitude now is about 4·5, and it is unlikely to be observed further in these latitudes. Observers in the southern hemisphere should, however, be able to follow it for some time yet.

Quénisset's comet is now near the sun, and practically unobservable; its calculated magnitude is about 7·0, and,

travelling southward, it is about half-way between μ and ϵ Serpentis.

Beljawsky's comet is now fainter than the sixth magnitude, according to the ephemeris, and is three or four degrees north-east of Antares; it is practically unobservable, and is apparently travelling southwards, while receding from both the sun and the earth.

THE DISTORTION AND APPARENT DILATATION OF CELESTIAL OBJECTS AT THE HORIZON.—Mdlle. G. Renaudot has an interesting article on this subject in No. 2002 of *La Nature*, where she discusses the numerous explanations which have been put forward since the time of Aristotle. Special attention is paid to the explanation suggested by Alhazen, which calls in an optical flattening of the celestial vault causing the observer to feel that the stars, &c., are nearer to him, *i.e.* they should subtend a greater angle than they really appear to do. The interest of the article is greatly enhanced by some excellent photographs, taken by M. Quénisset, illustrating the distortion of the solar disc near the horizon.

EARLY VISIBILITY OF THE NEW MOON.—Referring again to Mr. Horner's observation of the new moon, Mr. Whitmell, in *The Observatory*, makes one or two minor additions to his previous results, and quotes another case, more remarkable still, inasmuch as the moon's age was only 14·75 hours, which has been brought to his notice. Mr. Hoare, of Faversham, sweeping the horizon with a 4-inch refractor on July 22, 1895, picked up the crescent moon, and after steady gazing was able to hold it with the naked eye. In this case the difference of altitude between the sun and moon was 4° 28′, the former being 2° 19′ below, the latter 2° 7′ above, the horizon, and the difference in azimuth was 7° 5′.

A NEW ASTRONOMICAL SOCIETY AND PUBLICATION.—We have received one or two numbers of the *Revista de la Sociedad Astronómica de España*, the monthly illustrated publication of this newly formed society. The review is well printed on good paper, and, in addition to the notices of the society, ephemerides and phenomena for the month, &c., it contains some excellent illustrated articles.

SOME PAPERS ON SPIDERS AND INSECTS.

TO the Proceedings of the Academy of Natural Sciences of Philadelphia for May Mr. N. E. M'Indoo contributes an article on the lyriform organs and tactile hairs of spiders. The lyriform organs, first observed in 1878, are sensory skin-structures peculiar to arachnids, and consist usually of several more or less nearly parallel slits, generally surrounded by a dark lyre-shaped band. In the simple type there are only two or three slits, with a common border; but in the compound type there are from four to thirty slits, all of which may be enclosed in a common border, or each of which may have a border of its own. The lyriform organs attain their greatest complexity in the hunting-spiders, "and as these usually contain more slits than those of the snarers or tube-dwellers, we must conclude that the method of capturing food has brought about these changes in the number of organs." As regards their precise function, the author is convinced that these organs have nothing to do with the sense of hearing, which appears to be undeveloped among spiders.

Owing to the rapid development and opening up of the country, and the consequent introduction of enormous quantities of seedlings, shrubs, trees, &c., Canada is specially liable to suffer from the accidental introduction of noxious insects. Accordingly, in May, 1910, the Dominion Parliament passed "an Act to prevent the introduction or spreading of insects, pests, and diseases destructive to vegetation." A copy of this Act is published as Bulletin No. 1 of the Entomological Division of the Canadian Department of Agriculture.

Among destructive insects that have reached Canada from Europe, two of the worst are the spruce budworm (*Tortrix fumiferana*) and the larch saw-fly, the ravages of which, coupled with those of other insects, to forests are estimated in a pamphlet by Dr. C. G. Hewitt, the Dominion entomologist, issued by the British Whig Publishing Company, Kingston, Ontario, to be as serious as the losses due to forest fires. Both insects are now spread over large areas in eastern Canada. The former species, which was first observed in force in 1909, defoliates balsam and spruce, and is reported to be doing the same to Douglas pine in British Columbia. Spreading like fire, in the adult stage this insect extends its range in a manner which cannot be controlled by ordinary means. The larch saw-fly, which thrives as well on the American larch as on its European namesake, was first observed in America in 1881, and two years later had spread over the New England States, whence it made its way into Canada by 1882. It attained a great development between that year and 1885, but after that practically disappeared until 1904, when it once more began to increase; at the present time it is spread over an area of 2500 miles. The best hopes of keeping the insect in check are centred on on ichneumon fly (*Mesoleius aulicus*), which appears to have been introduced for this purpose, although it is not quite clear whether the author is referring to its work in England or Canada.

In the September number of *The Entomologist's Monthly Magazine* Messrs. Porritt and Bankes give notes, illustrated by a coloured plate, of nine interesting species of British insects. Among these is the moth *Nonagria neurica*, taken for the first time in this country in the Cuckmere Valley, Sussex, in 1908, the British specimens hitherto referred to this species being shown to belong to an allied form. The caterpillar and pupa are described by Mr. H. M. Edelsten in a separate paper, also illustrated by a plate.

A list of the Macro-Lepidoptera of the Falmouth district, by Mr. W. A. Rollason, is published in the seventy-eighth annual report of the Royal Cornwall Polytechnic Society.

SEISMOLOGICAL NOTES.

IN the *Bulletin de l'Académie Impériale des Sciences de St. Petersbourg*, VI Série, October 1, Prince B. Galitzin adds another valuable contribution to seismometry. In No. 14, 1909, of the same Bulletin he pointed out that the azimuth of an earthquake epicentre can be determined from observations made at a single station. This direction is that of the first longitudinal wave, and is obtained by taking the resultant of amplitudes recorded in two directions at right angles to each other. Because horizontal pendulums are usually oriented north-south and east-west, the displacements are given in these directions. If, for example, one instrument recorded 10 mm. of north-south motion and the other 10 mm. of east-west motion, we see that the direction of motion was N.E.-S.W., but we do not know if it came from the north-east or from the south-west. This is the question that Prince Galitzin answers. If the front of the first wave is dilatational in character this motion is towards and down to the epicentre, but if it is condensational it is away and up from the same. This distinction is made clear by the records of a seismograph recording vertical motion. Observations have shown that sometimes the first movement of this instrument is upwards and sometimes it is downwards. The upward motion indicates a condensation, and the latter a dilatation. Between July 2, 1909, and June 8, 1911, Prince Galitzin has determined the position of forty-two epicentres by methods in which these rules have been followed.

In the issue of the same Bulletin for October 15 we find two more instructive communications from Prince Galitzin. The first deals with observations on the vertical component of earthquake motion. In connection with this, one result, based upon the records of six large earthquakes, is that the ratio of the vertical and horizontal components of movement is not constant, and is less than that which might be expected. Another result is based upon the apparent angle of emergence. Observations of nineteen earthquakes show that those with origins at distances varying between 2260 and 3840 km. have given values for these angles decreasing from 51 degrees to 42 degrees. From this latter distance up to 14,600 km. the values have increased up to 76 degrees. No definite law for the relationship between distance and the angle of emergence can yet be formulated. The second communication, which was brought before the Academy on September 21, deals

with the direction of motion of the second or transversal phase of earthquake movement. So far as observations have gone, the inclination of the plane of this movement with the plane passing through the epicentre, an observing station and the centre of the world has wide limits. Its value is probably influenced by the geological character of strata in the neighbourhood of the observing station and the epicentre. These investigations, which are treated from the mathematical and observational sides, are well worthy of attention from all seismologists.

Another interesting note we find in *Rendiconti della R. Accademia dei Lincei*, vol. xx., serie 5ª, 2nd sem., fasc. 1°. This is a short paper on the Latium earthquake of April 10, by Dr. G. Agamennone. The commencement of this disturbance was noted at Rocca di Papa at 10h. 43m. 39s., with a strong reinforcement one second later. At Rome the corresponding times were 10h. 43m. 41s. and 10h. 43m. 44s. These times indicate that the epicentre is nearer to Rocca di Papa than it is to Rome. If it is assumed that the records at each of these places refer to P_1 and P_2, tables like those of Zeissig give a distance of the epicentre from each of these stations. These distances are respectively 10 and 30 km. But as circles with these radii intersect at two points, we are left to choose between two epicentres, and as neither of these falls in with local observations, in this instance, at least, this method of determining origins is found insufficient. To solve the difficulty, Dr. Agamennone shows that the ratio of the differences in time of arrival of the two phases of motion at the two given stations, which we will call A and B, which is a constant, can be expressed in terms of the coordinates of the epicentre x and y and the distance between A and B. To solve this equation with two unknowns three assumptions are made, one, for example, being that the epicentre lies on AB, with the result that three solutions are obtained. The one selected is that which agrees best with local observations. The method is new, but it is hardly applicable to time observations made at only two stations.

EDUCATIONAL SCIENCE AT THE BRITISH ASSOCIATION.

BISHOP WELLDON'S presidential address has already been printed in NATURE, and it is therefore unnecessary to dwell upon it at any length. Teachers will find it animated by a high conception of the dignity and influence of their calling and a sympathetic insight into its characteristic difficulties, as might be expected from a one-time headmaster of a great English public school, though they may consider it lacking in practical suggestion for raising the profession in the general estimation, the public-school headmaster, happily for himself, being exempt from the necessity for considering such mundane matters as tenure, salaries, and pensions. To the general reader the most interesting part of the address will probably be Dr. Welldon's remarks on the relations of the Board of Education with the secondary schools and with the local authorities, which were prompted by his experience as deputy chairman of the Manchester Education Committee. He has learnt that the antagonism between the schools and the rates is a constant quantity, and that, accordingly, new services imposed on the authorities, commendable in themselves, as, for instance, the feeding of necessitous children and medical inspection, will in part be paid for out of funds which are needed for the performance of the older duties, unless, indeed, the Board of Education can induce the Treasury to grant additional help from public funds, a consummation which is likely to remain unrealised so long as the Parliamentary chiefs of the Board are chosen from ex-Treasury officials. In the Board's relations with the schools Dr. Welldon deprecated the tendency to a bureaucratic regulation of details, which is well known to characterise the dealings of the Board with elementary schools. Such methods may be wholesome when applied to unsatisfactory schools, for they assure a minimum of efficiency; but the maximum of efficiency cannot be obtained under a code of regulations—it requires freedom, spontaneity, and individualism for its growth.

The reference to educational topics, which has almost become customary in the presidential addresses to the whole association, was this year concerned with the position of technical education. Sir William Ramsay urged the need for the concentration of higher technical instruction in a few important institutions in place of its dispersal, as at present, through the many struggling technical institutes which have been established up and down the land by the local authorities. In one of the sectional discussions Prof. R. A. Gregory roundly stated that the position of higher technical instruction in England was in a deplorable condition. Official statistics showed, he said, that fewer than 2000 students were taking complete day courses in the whole of the technical institutes of the country.

The initial discussion in the section took place upon the report of the committee on overlapping between secondary schools and universities and other places of higher education. Prof. Smithells, in presenting the report, made it clear that it dealt only with a certain amount of evidence—in some cases conflicting evidence—and that its conclusions must be reserved for a later meeting. The complaint is made in England, and also in America, that the secondary-school course is not properly articulated with the university course, and that on one side the schools are retaining pupils who ought to be at the universities, whilst on the other the universities, owing to the lack of preparation of many of their students, are wasting power upon elementary training. Upon the evidence submitted, and apart from theories as to the position of pass Moderations and the Previous examination in an organised educational course, Oxford and Cambridge appear to have little complaint to make. At London and in some of the provincial universities the overlapping is more serious. The London external system renders it possible for students to pass their Intermediate examination, and even to take their degree, direct from school, while, on the other hand, a large amount of preparation for matriculation takes place in the London colleges. It must be remembered, however, that many of the students enter the university by way of evening classes or even after a short experience of business or professional life, and for these preparatory work must certainly form part of the university course. The overlapping at London is considerable, but to some extent it cannot be avoided; and, as was suggested in the discussion both by Prof. Smithells and by Mr. Daniell, overlapping in the special circumstances of London and of the larger provincial universities is by no means synonymous with waste of educational resources.

As between the technical institutions and secondary schools, no evidence is yet forthcoming to show that the overlapping is serious. Indeed, the facts appear to be the other way. Less than one-fifth of the students in English institutions have passed a university matriculation examination or its equivalent, and nearly one-fourth have been admitted without passing any examination test whatever. The secondary schools and the technical institutions are thus shown to have but little organic connection, and the great bulk of the students of the latter have probably received no secondary education at all. It will be time enough to discuss overlapping when the main stream of pupils in the higher technical institutions have previously laid the foundation of a good general education in the secondary schools, a condition of things, however, which is not likely to be facilitated by the drastic proposal of one speaker that boys should not be allowed to remain at the secondary schools after their sixteenth year, but should be passed straight on to the technical institutes. The evidence from the secondary schools is still incomplete. As might be expected, the public-school masters with one accord proclaim the advantage to be gained by their boys in the last year or two years of school life. In these years they learn self-control, the use of authority, and the most valuable parts of character training; and the schools, with their ample resources, find no difficulty in allowing their boys a reasonable amount of specialisation in the subjects which they will afterwards study at the universities, and in preparing them for the transition in method between school and college.

For the present, and until the committee reports its reasoned conclusions, it may be taken that in the gaps between the different parts of our educational system the

real danger lies, and that, as for overlapping, in Principal Griffiths's words, "Time is not lost when the same country is retraversed under a different guide."

The principal item on the programme on the second day of the meeting was a discussion on the place of examinations in education, opened by Mr. P. J. Hartog and Miss Burstall. The papers, and the discussion which followed them, may well be taken as marking a new stage in the treatment of the subject. Hitherto there has been more than a disposition on the part of educationists to anathematise all external examinations. As Mr. Hartog indicated, little good has come of it: the external examining bodies are not one penny the worse. It is now realised that for some purposes, as, for example, the selection of candidates for the State service and the certification of professional skill, the public have a right to demand an examination by some independent body. Sir William Ramsay, who intervened early in the discussion, and was by far the most outspoken opponent of the conventional type of examination, at least agreed that "we must be guarded against professional murder." The problem is thus seen to be, not the abolition of examinations, but their reform, and to this end the section strongly supported Mr. Hartog's suggestion that the time is ripe for a Royal Commission to inquire into the whole subject, but with particular reference to the entry into the Civil Service. All the speakers were agreed that teachers should increasingly cooperate in the "branding of their own herrings." Miss Burstall showed how influential the teacher members had been on the Joint Matriculation Board of the northern universities, not as examiners, but as members equally responsible with their colleagues for the scope and arrangement of the examinations. There are other instances in which the cooperation of teachers has been carried very far, and the committee which was appointed as the result of the discussion might very well devote its time to the preparation of a detailed account of some of these experiments and to a report upon the degree of success which has attended them.

Another aspect of the subject was raised by Mr. Hartog and the president of the section in their remarks upon the suitability of many of the examinations for the purpose they have to serve. It is almost impossible by examination to test the *moral* of the candidate; and there are many gifts of tact, alertness, resourcefulness, and the like required in the State service and in professional life which the present system of examinations completely passes by. Mr. Hartog gave an interesting account of a written test which he had himself applied to a group of candidates to ascertain in what degree they possessed certain of these qualities; but such tests are difficult to devise, and—*sub rosa*, be it said—they demand corresponding qualities in the examiners. Dr. T. P. Nunn was for once *advocatus diaboli*, and gave a thoughtful restatement of the arguments for external examinations which satisfied the generation that founded the University Locals. In essence it was the case for the influence of a master in a subject exerted upon teachers and upon the study of it generally through the annual paper of questions. But even in Dr. Nunn's hands it failed to carry conviction; the general level of teaching in schools is much higher in all subjects than it was in days gone by; an increasing number of teachers come under the personal influence of one or other of the masters of their subject; and among those who do not, the professional periodicals and the numerous associations and conferences which are so marked a feature of educational life in this generation supply opportunities for the spread of right method and sound doctrine superior to any that a mere paper of questions can afford.

It is the practice of the sectional committee to set apart one day for the discussion of recent psycho-physical research as connected with education. This year the central topic was that of defective children. A special committee, of which Prof. J. A. Green is secretary, reported the result of an inquiry into the tests actually used in the diagnosis of feeble-mindedness. The summarised replies received from school medical officers and others show that there is a grave need for some standardisation upon scientific lines in the matter both of diagnosis and subsequent treatment. Dr. Shrubsall gave a detailed account of the methods employed under the London Education Authority for the testing of mental deficiency. Without presuming to criticise these methods in particular, it is very clear that the methods of diagnosis generally employed are frankly empirical and of almost bewildering variety, and that partly in consequence of this and partly owing to the lack of precise knowledge on types of mental deficiency in relation to the general problems of education there is very little connection in most cases between the initial diagnosis and the subsequent treatment.

Dr. A. F. Tredgold presented a careful discussion on the nature of mental defect and its relation to the normal. He suggested that neither from the intellectual point of view nor as a result of psychological analysis or histological examination of brain structure could justification be found for regarding the difference between the normal and the defective as in its essence qualitative, although the quantitative differences may and do result in minds of a very different order. In defining mental defect it was necessary to go much deeper than mere ability to perform certain occupations. He would himself define it as a condition due to arrested or imperfect brain development, in consequence of which the individual is incapable of maintaining an independent existence. Dr. Abelson followed with a description of a series of tests, in some measure comparable with Binet's, which he had employed for the last three years upon backward children. The problem of the mentally deficient is so pressing from the social point of view that it is not surprising that the discussion soon turned rather upon this aspect of the question than upon the report of the committee. Once defective always defective, appears to be the rule. "I have never yet," said Dr. Tredgold, "seen a mentally defective converted into a normal being"; and again, Miss Dendy: "We cannot train the defective child out of his defect; he simply grows into a trained feeble-minded man."

The absolute necessity, in the interests of society, of preventing the multiplication of the unfit, and the inefficacy of the present law, which allows the feeble-minded adolescent at sixteen years of age to go out into the world, none saying him "Nay," dominated the mind of speaker after speaker. Dr. Saleeby, Mrs. Burgwin, Prof. Dendy, and Mr. McLeod Yearsley took part in the discussion. The last named urged especially the importance of segregating the feeble-minded deaf. Miss Dendy showed how much can be accomplished even under present conditions in her description of the feeble-minded colony at Sandlebridge, which, beginning ten years ago as a small residential special school for little children, and resolutely declining to accept any new pupil over thirteen years of age, has grown into a colony with 270 inhabitants, with two farmhouses, with cottages, a laundry, carpenters' and plumbers' shops, and six residential houses, on about 120 acres of land. In the ten years, out of 274 children who have been admitted, only eighteen can be spoken of as failures whose parents have broken their promise to leave them permanently in the school. Very interesting was Miss Dendy's account of how it had been possible to turn to the service of the community those streaks and patches of intelligence which are found in almost all feeble-minded children, and, unfortunately, are often made the basis of a training in tricks which are of no use either to the individual trained or to anyone else.

On the last day of the meeting papers were read on practical education in H.M. dockyard and naval schools, by Mr. Dawe, headmaster of the Dockyard School at Portsmouth, and Mr. W. H. T. Pain, principal instructor of boy artificers on H.M.S. *Fisgard*. The *Fisgard* is quite a recent establishment, but the Dockyard School in one form or another has existed for nearly a hundred years. It was claimed by its supporters in the discussion, among them Sir William White, a former pupil in a dockyard school, Profs. Worthington and Gregory, Dr. Kimmins, and Dr. Varley, that the schools might well be taken as a model by authorities responsible for any form of specialised technical training. Of their success there can be no question. Every professor of naval architecture in the kingdom at the present time has been through one of H.M. dockyard schools; of the principal officers in the constructional branch of his Majesty's Navy the same may be said, and also of the majority of naval architects at the head of private shipbuilding firms, while the lower ranks

of his Majesty's dockyards are mainly staffed by ex-pupils. The outlay for which this wonderful return is obtained does not exceed 4000*l*. per annum.

From the beginning the Admiralty has insisted on the faithful observance of two guiding principles. In the first place, the apprentices who attend the school do so partly in Admiralty time. At present the five periods a week are taken, three from the boys' free time and two from Admiralty time, and Admiralty time spent at the school is paid for. In the second place only those pupils are retained who are found to have the requisite ability and industry to profit by the higher instruction; a continuous process of sifting goes on, and the waste of effort is thus reduced to a minimum. Those pupils who go out comparatively early find their position on the wage-earning staff; and, as Sir William White testified, they are altogether different from ordinary workmen, because of the training, short as it may be, which they have had in the school. At the same time, there is sufficient material retained for the training of officers, who will ultimately fill the higher constructional posts. A third principle has been rendered possible of application in recent years, and no candidate is now admitted who has not obtained a sound preliminary education. The number of apprentices in attendance is 180; and the school is arranged in two sections, which attend on alternate days. The full course extends over four years, but there is a weeding-out process at the end of each year. Of those who complete the course a few are selected by examination from all the dockyards for an advanced three-year course at the Royal Naval College, Greenwich, after which they join the Royal Corps of Naval Constructors. The competition for admission to the dockyards as apprentices is severe, and therefore at the outset a careful selection is possible.

The late Lord Spencer, when First Lord of the Admiralty, appointed a committee to consider whether the schools might be abandoned in view of the enormous advances which had been made in the provision for elementary education. Happily for the nation the committee's verdict was unanimously in favour of their retention. The development of to-day in the provision of technical instruction is held by some to justify a fresh proposal for the abolition of the schools, and the transfer of their pupils to the municipal technical schools of the dockyard towns. It is to be hoped history will repeat itself and that the schools will be allowed to continue their unique work. As Prof. Gregory said, they are at least a generation ahead of most of the other technical institutions of this country. Their close association with the dockyard has benefited both. Prof. Worthington pointed out how the problems of the dockyard are brought to the schools for solution, and he also dwelt upon the interest and pride which the rank and file of the yards take in the schools. To sacrifice a century-old tradition for the sake of saving a few thousand pounds would be a deplorable mistake, particularly at this juncture, when the Admiralty's example will be most valuable to administrators and educationists, who have good reason to be dissatisfied with the condition of technical education in the country generally.

SOME ENGINEERING PROBLEMS AND THE EDUCATION OF ENGINEERS.[1]

IT is a consequence of the scientific basis of engineering that it is international, not national. Scientific advances are not restricted within political boundaries. If we gave the world the steam turbine, Germany returned us the gas engine and Diesel engine. Ability to appreciate the value of new discoveries, and readiness to take advantage of them, depend as much on a widespread scientific education as the making of the discoveries themselves.

My distinguished predecessor, out of a long and varied experience in the development of the most modern of the many branches of engineering industry, discussed the economic conditions of production on which successful manufacture depends. It will be more natural to me to deal with some of the technical principles on which the successful design of engineering structures is based.

[1] From an address delivered to the Institution of Civil Engineers on November 7 by Dr. W. C. Unwin, F.R.S., president of the Institution.

Strength of Materials.

The object of a study of the strength of materials is to determine the proper dimensions to be given to parts of machines or structures, in order that they may resist the straining actions to which they are subjected without breaking or prejudicial deformation. It is a modern study, for the earlier architects and builders seem to have had no definite knowledge; only it may be noted that the earliest buildings were the most massive. The Egyptian columns were not more than five or six diameters in height, the Greek about nine. Mediæval buildings depend more on considerations of stability than of strength; but there are mediæval columns carrying arches which are twenty-six diameters in height.

So far as we know, however, Galileo (born 1564, died 1642) was the first man of science definitely to consider strength. He found that a rod of copper suspended vertically might have a length of "4800 arms," or, say, yards, before breaking in tension by its own weight—a reasonable result. Having no conception of elasticity or of variation of stress due to variation of deformation, he seems to have assumed that bodies always broke by tension, and that tension was uniform at the surface of fracture. Applying these notions to determine the strength of a cantilever, he supposed the whole cross-section would be in tension uniformly distributed. He arrived at an equation for bending strength which for rectangular sections is right in form, but affected by an erroneous constant; and he acutely deduced the result that, while a model of a structure might be strong enough to carry a load, the structure itself might be so large as to break by its own weight. This is the germ of the law of a limiting span for bridges. On the same false assumptions Grandi, in 1712, published elegant and correct demonstrations of what we know as solids of uniform resistance to bending. It is not the first instance in science of false assumptions leading to partially correct results.

It was not until 1660 that Robert Hooke discovered the fundamental law that stress is proportional to strain in elastic materials. It was not until 1680 that anyone made further experiments on the strength of materials. Then Mariotte made rough tests of very small bars of wood and glass strained in various ways. He first perceived that in flexure part of the cross-section is in compression and part in tension, and placed the neutral axis for a rectangular bar at half the height, correcting Galileo's result. It was not until 1776 that Coulomb determined the position of the neutral axis for simple sections, and not until 1824 that Navier determined it for all sections.

In 1729 Muschenbroek, at Leyden, published the results of what may be considered the first tests of materials made with precision. He made tension and bending tests, and tests of long columns, but on a very small scale. Perronet, occupied with the construction of the Bridge of Neuilly, in 1758 constructed the first comparatively large testing-machine, a machine capable of applying a stress of 18 tons. Rondelet, in 1787, constructed a testing-machine with knife-edges, and with a screw arrangement for taking up the deformation of the test-bar. It was the first machine containing in principle all the essential elements of a modern testing-machine. Labardie, soon after, constructed a 100-ton machine for the Port of Havre, and Girard carried out with it the first tests on a large scale of the elasticity of materials. In 1813 and 1817 Brunton and Company and Captain Sam Brown constructed cable-testing machines.

Theory of Elasticity.

A very great step in the simplification of the mathematical expression of formulæ of strength of materials was taken by that very remarkable English physicist Thomas Young (1773–1829), who defined the coefficient of direct elasticity, or Young's modulus, and first considered shear as an elastic strain. The time had come for the development of a general theory of elasticity. Navier, in 1827, first investigated the general equations of equilibrium of an elastic solid, starting from an assumption as to the molecular constitution of matter. Navier's equations are still accepted, though part of his reasoning is considered to be unsound. At the same time, Cauchy founded the theories of stress and strain, and Lamé and Clapeyron made important developments.

Reverting to experimental work in this country, early in the last century George Rennie made investigations of the resistance of structural materials, and Peter Barlow made experiments on the strength of timber at the Dockyard and at the Arsenal. This led to his association with engineers; and he assisted Telford in calculations for the Menai Suspension Bridge. His "Essay on the Strength of Timber," in 1817, when developed in later editions, may be regarded as the first general treatise in English on the strength of materials.

Down to about the end of the first quarter of the last century most of the knowledge of strength of materials was due to the work of Continental engineers and physicists. Then an advance was made here. Thomas Tredgold in 1820 published "A Treatise on the Principles of Carpentry." This dealt scientifically and practically with all the then known data of resistance. His book on the steam engine, dealing specially with questions of strength, was published in 1827, and republished down to 1850. It has been rather a fashion amongst elasticians to ignore or depreciate the work of Tredgold. But he had a practical insight into what was important and what was negligible in engineering problems greater than that of writers with more ample mathematical resources, and he rendered essential services to the engineers of his time.

A little later Prof. Eaton Hodgkinson began the researches on strength of materials which give him a foremost place among careful experimenters. He is credited with the discovery of permanent set and of the position of the neutral axis. His paper of 1830 on iron beams, and that of 1840 on columns, were very valuable contributions to practical science.

There is not time to trace further the history of the science of strength of materials. Experimenters and laboratories in the last fifty years have increased enormously, and theoretical investigations have been pushed to great lengths. But I wish to take the opportunity of paying a tribute to one who seems to me the prince of observers in this branch of science. I mean the late Prof. Bauschinger, of Munich, professor of mechanics and graphic statics at the Technical High School at Munich for twenty-five years. There he established a laboratory, rather more for research than instruction, where engineering experiments were carried out with a thoroughness and delicate accuracy never previously equalled. In 1868 he published the result of indicator observations. But his special field of work was that of tests of materials. He created the first public laboratory for this purpose. He first applied Gauss's method of reading by reflection in instruments for measuring the deformation of bodies when strained.

Amongst many researches remarkable for their extent it is only possible just to mention one on cements and cement and lime mortars, demonstrating, amongst other things, the importance of fine grinding, and one on the building stones of Germany. His researches on timber first indicated the precautions necessary for securing comparable results, especially the law of variation of strength with moisture. He carried out many researches on cast iron, wrought iron, and steel, especially some with reference to the variation of the position of the elastic limit under different conditions of straining. Perhaps one of his most important achievements was the foundation of the International Association for Testing Materials.

Testing Materials for Quality.

Down to the middle of the last century the only generally used tests of the quality of iron and steel used in construction were bend-tests, and in certain cases shock-tests. Such other researches as were made were directed to a different object—either to determine the constants in formulæ on which engineers relied or to prove the sufficiency of complete structural members. It was the introduction of Bessemer steel, and cases of unexpected failure of steel structures, which forced on engineers the necessity of systematic tests of quality. An important series of tests carried out by the late Mr. D. Kirkaldy in 1860 led to the adoption of a tension-test as the usual test of quality. Its special merit is that exact figures can be specified for elastic limit, resistance to fracture, and elongation.

With the introduction of definite tests, the importance of accurate and reasonable specifications became urgent. Recently the work of the Engineering Standards Committee has done very much to guide the engineer in securing trustworthy material without imposing conditions too irksome or costly on the producer. Hence it has come about that the testing engineer has been created, having functions partly as an investigator of the properties of materials, partly as adviser of manufacturers, and partly as inspector of material.

Application of the Science of Strength of Materials to Practice.

The general object of the accumulation of experimental and theoretical knowledge of strength of materials has been to determine the minimum amount of material and the best disposition of it in machines and structures to secure safety. Putting it another way, by theory the stress conditions due to any given straining action can be calculated; then it has to be determined what is the greatest permissible working stress, and in what way does it depend on such physical properties of the material as can be ascertained by testing.

The oldest, and still the most common, method of proceeding is to reduce the straining actions to simple tension, thrust or shear, by calculations based on the assumption of Hooke's law, and to provide material enough to limit the intensity of these stresses to a fraction of the breaking strength of test-pieces similarly strained. The ratio of the breaking strength to the working strength is termed the factor of safety. In by far the largest number of cases with which an engineer has to deal, the breaking strength of a structure cannot be calculated, for Hooke's law ceases to be true for stresses much below the breaking stresses. Hence the engineer sometimes proceeds one step further. He tests a scale model of a structure to breaking, and from this deduces the breaking load of the full-size structure by the law of similarity.

In the case of complex structures, the determination of the exact maximum stresses in which are beyond the resources of mathematical analysis, the value of model experiments is unquestioned.

Now it is easy to show that the ratio of the breaking stress to the working stress, or the breaking load of a girder to the working load, is not a real factor of safety; the point at which danger occurs in different cases is not a fixed fraction of either the real or the calculated breaking load. It has even been contended, with some plausibility, that the fashion of dividing the breaking stress by a factor to find the working stress is a barbarous method. The factor must be varied for different conditions, and can only be fixed empirically.

The ductile materials chiefly used in construction *yield* or suffer a large deformation at about half to two-thirds of the breaking stress. The deformations, if the yield stress is exceeded, would be, at least in very many cases, far too large to be tolerated in either machines or structures. If the yield stresses are taken as the limits of safety, then the real factor of safety is only about half the ratio of the breaking to the working stress. Further, the ratio of the yield stress to the breaking stress is not a very constant ratio.

Shall we, then, drop the breaking strength and adopt the yield-point as the measure of the constructive value of a material? Many constructive materials, such as stone, timber, and cast iron, have no yield-point. Besides, even for ductile rolled material, such as mild steel, the point ordinarily determined as the yield-point is not a very fixed point for a given material. It depends a little on the rate of loading. Yielding really begins at the elastic limit, a point below the yield-point, spreading along the bar and becoming general over the bar at the yield-point.

Some writers assume that the elastic limit as determined in a tension test is the real measure of the constructive strength of a material; but I am not sure that this is not, when rigidly examined, the most ambiguous and elusive of all the measures proposed. In what sense, then, is the elastic limit found in a tension-test to be understood?

No doubt there are cases where the primitive tensile elastic limit does fix a superior limit to the stress consistent with safety. But it cannot be taken generally as an exact

measure of constructive value, though it certainly is a valuable indication. Further, the elastic limit in compression is seldom observed, and the elastic limit in shear is experimentally almost unknown. Yet resistance to shear is probably for ductile materials the most important element of constructional value. It would be interesting to have the elastic limit in torsion of thin tubes accurately determined.

Hence, whether we take the breaking stress, the yield stress, or the primitive elastic limit, we have not found a satisfactory rational basis for measuring the constructive strength of a material. There is not a fixed ratio between the greatest safe working stress and either of these. But I do not wish to be understood as depreciating the value of the determination of breaking stress, yield-point, and elastic limit in testing materials.

Valuable as are the data of breaking strength, yield-point, and elastic limit determined in a tension test in influencing the judgment of the engineer, they do not furnish any purely rational rule for fixing the working stress for designers. Experience in similar cases must always be the ultimate appeal.

Compound Stress.

So far, all that has been said relates to cases of simple tension, thrust, or shear. But in a very large number of cases two of these stresses are combined. In such cases the theory of elasticity furnishes the principal stresses and the principal strains; but the question, What is the criterion of safety? involves another of the unsolved problems of engineering. Two schools arose amongst theorists, one holding that the maximum stress, the other that the maximum strain, determined fracture. For simple stresses, either assumption leads to the same result. It is not so with compound stress. Very early Coulomb suggested that fractures would be determined by shear, as is the case with cast iron under compression. The subject is now under investigation experimentally, and, speaking generally, it seems that for ductile materials the material gives way at some limit of shearing stress, while for brittle material in tension the principal stress is the best criterion of strength.

Comparative Structural Value of Materials.

It is only when comparing two different materials that an engineer needs to consider relative constructive value, and then he bases his judgment on all the properties of the material. Ordinarily, the safe working stress is fixed by experience in similar cases, theory helping mainly in explaining why in different cases different stresses are suitable. The history of engineering design is a history of experiments in construction, in which by trial and error right proportions have been found; and in the settlement the different relative importance of cost and weight enter into the question, as well as considerations of mechanical strength. The fact that scientific data and rational, or semi-rational, formulæ are conveniently used should not be allowed to conceal the fact that an empirical element always enters into the solution.

New designing is really a process of comparison, in which the engineer extends experience in known cases to new conditions; and the problem is in what proportion dimensions must be varied to allow for differences of size, of material, of loading, of speed, or of form.

Most practical problems in designing for strength reduce themselves, if traced to their foundation, to applications of the law of similarity. At a time when steam engines all worked at about the same steam pressure, it was broadly stated that the drawings of an engine of any size could be used for constructing engines of any other size by merely altering the scale of the drawing. So-called mechanical instinct is, no doubt, really reasoning based on the law of similarity.

In the case of machines, another consideration enters. The weight stresses are not usually important, but the inertia stresses due to variation of velocity or direction of motion are very important. The stresses in a fly-wheel rim due to radial acceleration are proportional to the square of the rim velocity, whatever the cross-section. Hence fly-wheels are equally safe in this respect if the rim velocity is the same, or if the rotations per minute are inversely as the diameters.

Engineering Education.

I turn to another subject, which seems to be appropriate in a year in which the institution has held a conference on the education and training of engineers. An important change is going on in all types of education. In all it is being recognised that they should be such as to afford a training for the duties of life. The term "engineer" is used in such wide and loose senses that it is necessary to be explicit as to one's point of view. There are vocations associated with engineering work for which no special training is absolutely required beyond that of the factory or commercial office, or for which any other training required is different and more limited in scope than that of the professional engineer or director of engineering works. But the conference considered the case of those who aim at becoming ultimately professional engineers, that is, men who advise, design, and direct the execution of works of civil engineering in the wide sense in which that term is used in this institution. If the course of training of such men is provided for, the less complete training of men for lower grades of service is not likely to be wanting. But I do not think that we distinguish sufficiently at present the different type of education required for leaders and subordinates, the heads and the hands.

It must be recognised that the professional or consulting engineer is not solely concerned with technical problems, though as to these he must be an expert. But he is more and more concerned with economic, legal, and commercial problems of much intricacy, and must be prepared to meet men of affairs and of liberal education on an equal footing.

Now the earlier great engineers in this country had no formal technical training; indeed, very little general education either. Brindley, George Stephenson, Fairbairn, had only parish-school education; Smeaton, Telford, and Watt only grammar-school education. They picked up even their practical experience gradually and casually. They differed in this from their contemporaries in France. Perronet, Gauthey, Rondelet, and Navier, for instance, were of a more academically educated type.

It is, no doubt, due in part to such early conditions of English engineering, in part to the narrow and unscientific character of secondary and university education in this country, that until recently the education and training of engineers has been so unacademic and unsystematic.

Preliminary Education.

A very great obstacle to the progress of technical education in this country has been the want of any definite aim—the unsuitable character and poor average quality of our secondary education. Grant whatever can fairly be urged as to the honourable spirit, the pluck, and resourcefulness of boys from the better public schools; grant also the value of dead languages as a means of culture for those who really master them, it must still be recognised that the average boy, to some extent, still leaves school sadly unfitted for any form of higher education. The success of the clever and brilliant few, educated for university prizes, has obscured the poor quality of the intellectual equipment of the average many.

Happily, if the state of things is not yet satisfactory, if secondary education is still unorganised, and the schoolmaster is only partially converted, still science has obtained a footing, and school-leaving and other examinations have secured that the average lad is better taught.

It was partly a cause, partly a consequence, of defective school education that the great universities have not addressed themselves, in a responsible and scientific manner, to securing that candidates for admission to higher courses had reached a reasonable standard. Still less were the engineering schools, with one or two exceptions, able to insist that students were properly prepared for technical instruction. It is only recently, and partly under pressure from the institution, that a fairly satisfactory entrance examination has been prescribed in some English and colonial engineering schools. To admit lads with imperfect preliminary education to advanced instruction lowers the whole standard of work in the classes.

An erroneous opinion has prevailed that technical instruction requires little or no literary and scientific education to

prepare the way for it. I noticed the statement in the address of the Chancellor of St. Andrews, on the occasion of the quincentenary of the University, that the test now imposed for entrance would in some respects compare not unfavourably with that for graduation about half a century ago. In the best engineering schools a similar change has occurred, and should, indeed, make further progress. The possibility of effective technical teaching depends on suitable previous preparation; and on this point the committee of the institution in 1906 came to very decided and definite conclusions, and laid down explicitly a scheme of school education for engineering students.

Technical Education.

It is only in modern times that universities came to be regarded as solely concerned with a general liberal and, except as regards medicine, an entirely non-technical education. "The colleges were in their inception," says Mark Pattison, the rector of Lincoln, "endowments not for the elements of a general liberal education, but for the prolonged study of special and professional faculties by men of riper age"; and he lamented that they no longer promoted the researches of science or directed professional study. That state of things is happily changing, especially in the modern provincial universities.

The new vocation or profession of engineering grew up in this country with very little academic encouragement. It is true that after 1840 engineering schools were attached to a few universities. But they were generally unendowed, unequipped, or uninfluential. The most distinguished of them was that at Glasgow, where the Regius professorship was held by Gordon and Rankine.

Meanwhile, in France and Germany there had long existed remarkable engineering schools with distinguished teachers. The Paris Ecole Polytechnique was instituted in 1794, the Ecole des Ponts et Chaussées in 1795, the Ecole des Mines in 1778, the mining school at Freiburg, where many foreigners obtained education in 1765. In the first quarter of the nineteenth century were established the technical high schools of Karlsruhe, Hanover, Berlin, Dresden, Vienna, and the École Centrale at Paris. The great Zürich Polytechnicum dates from 1854.

With one exception, I do not think there were any engineering schools in this country with what could be regarded as a reasonably complete and satisfactory curriculum or equipment before 1870. In giving this date I am passing over the system of education adopted by the Admiralty for naval engineers and architects in 1843. Sir Alexander Kennedy established the first college engineering laboratory in 1878, and from that may be dated the beginning in this country of a necessary equipment of engineering schools. There is now a number of university engineering schools, or schools of university rank, directed by teachers of eminence not only in science, but in practical engineering, with systematic courses of instruction covering broadly all branches of engineering up to the graduate stage, and of a thoroughly practical character. Quite recently a beginning has been made of post-graduate instruction of a specialised character. It is only in a post-graduate course that engineering students can be usefully or efficiently employed in research.

Advanced Education and Practical Training.

I cannot help thinking that there is a tendency amongst some practical engineers to suspect those of us who are interested in formal technical instruction of indifference to the value of practical experience. But surely that is a mistake. Most engineering professors are themselves engineers of considerable practical experience. What, in fact, they do somewhat doubt is the value of so much practical experience as an ordinary apprentice gets who goes straight into works without technical training, and who has to pick up his knowledge as he can. At the best, his experience is a narrow one. Some of the jealousy occasionally shown as to college training seems to arise from the feeling that it interferes with the traditional English system of articled pupilage, which, so far as I know, hardly exists in any other country. It does seem to me that the old apprenticeship system for professional engineers, taken by lads direct from school, was uneconomical, wasteful of time, involving unnecessary drudgery, and in some respects unfair.

There is another consideration as to the pupilage system as it existed forty years ago. It was suitable only for the wealthy. But many of the most hard-working, capable, and even brilliant students are not of the wealthy class. In these days there are ladders from the elementary school to the university and the technical college. It would be a loss to the country and the profession if really able, but comparatively poor, students could find no way to employment. In this competitive time we can least of all afford to neglect or waste intellectual ability.

The institution has by its system of examinations expressed its view of the importance of such theoretical and practical technical education as it is the object of technical schools to give, while at the same time it has done what is possible by its by-laws to encourage or require a term of pupilage or apprenticeship as a means of acquiring experience. Further, in the report of the committee of 1906, while insisting on the value of pupilage or apprenticeship, it has most definitely expressed the opinion that a three years' course in a technical college is equally necessary, and should form an integral part of the training of an engineer; and this conclusion was endorsed by a large majority of the engineers who were consulted by the committee.

The question arises, and I think it is a serious one, how far engineers now are taking any steps to carry out the recommendations of the institution committee as to the requirement of preliminary training antecedent to pupilage. It is clear that young men will not incur the expense, the labour, and the delay of a college course if it gives them no advantage in entering the profession.

Some inquiries were lately made by the institution of more than a hundred engineers in various branches of engineering as to the conditions on which they accepted pupils or apprentices. In a few cases it appears that pupils or apprentices are required to have passed an examination equivalent to the Studentship examination of the institution. In a very few cases the possession of a degree is accepted as a reason for shortening the period of apprenticeship. But what is desirable is that a lad should reach the standard of the Associate Membership examination or the examination for a first degree before entering on pupilage. If he does not he will only be able to reach it by cramming, which, though not quite useless, is much inferior to a systematic course of study. As a matter of fact, however, within my own knowledge the colleges have more influence than these returns seem to show; and, especially in the case of the provincial universities, local patriotism ensures preference to men trained in the local university.

The Transition from College to Practice.

It seems to me that the great efforts made during the last forty years, and the expenditure incurred, largely from private sources, in establishing engineering schools lack in one respect full recognition by the profession. Many engineers have given generously in money and in time; but engineers in general might do more in facilitating the transition from school to works. With an experience of twenty years, I believe that more organised and recognised relations between the schools and offices and works are desirable and possible. The most difficult part of a young engineer's career is the step between college and full capability in some special branch. No engineering school can prepare students completely for any special position in the engineering field without very undesirable narrowing of the scope of the instruction. Two years of pupilage or employment is desirable as a transition period; and the difficulty is that generally engineers expect that someone else should have the task of rounding off the college training. Even in the United States it is perceived that, to make technical education effective, the employer must shoulder a part of the load imposed by the old apprenticeship system, which in the United States has been to a great extent thrown on the schools.

I am therefore much in sympathy with the proposal that there should be an endeavour to produce some coordination between the colleges and employers by making an inquiry as to the conditions under which well-qualified

students may be able to get practical training, whether they seek employment later in the mechanical or electrical branches of engineering or in constructional or administrative work. Some scheme might be evolved linking the colleges and the manufacturing, municipal, or other public works, so far that the first stage of practical experience might be gained under conditions less haphazard than at present. No doubt college graduates who want to fit themselves for service in India or for starting in private business are fairly asked to pay for the privilege of entering works or office. But in other cases well-trained students who are quite capable of being useful might very well be taken on easy terms, for a trial of a year or two, in the expectation that they would remain afterwards as valuable assistants. In the engineering departments of municipalities greater facilities for apprenticeship might be given. By choosing technically well-educated lads and directing their practical training, they would form a loyal staff, ultimately more competent and useful than others less educated, but selected as more immediately useful. Further, it is now proved that technically educated lads are very fit, with some experience added, for the commercial branches of an engineering business.

If a university degree or college diploma is to be taken as a qualification for beginning an engineering career, it must not be overlooked that degrees and diplomas are of very varied value, and that one great function of a college is to distinguish the more and the less capable amongst its students.

I believe there are no schools of university rank where the work is more strenuous, the methods more practical, or new ideas more welcome, than in the best of the engineering schools of the day.

I have touched on various subjects, unavoidably in a short address, with some one-sidedness. We have been driven lately to recognise how intimately the very existence of society as now constituted depends on the work of the engineer. It is because I have come to believe in the importance of coherent and systematic instruction and in the value of the play of mind on mind and the influence of generous rivalry, best enjoyed at a plastic and impressionable age during studentship, that I have ventured to urge the claims of engineering schools in preparing the engineer for service in shaping the destinies of the Empire.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—A scholarship of 150*l.* a year for three years has been awarded by the Board of Agriculture and Fisheries to Mr. Gilbert E. Johnson, a student in the department of zoology. This scholarship is one of the number recently founded by the Board with the object of encouraging research in agriculture. Mr. Johnson is at present engaged in research in connection with the subject of eel-worms.

OXFORD.—The statute allowing honour students in mathematics and natural science to dispense with Greek in Responsions passed Congregation on November 7. No canvas had been made on either side, and the division, showing 33 for the statute and 11 against, was without any particular significance. The real struggle will take place when the measure is submitted to Convocation, the ultimate legislative authority of the University. This will probably take place before the end of the present term.

SIR HENRY CRAIK, K.C.B., M.P., has accepted the principalship of Queen's College, London, in succession to Canon G. C. Bell, resigned.

AT a meeting of the governors of the South-Eastern Agricultural College, Wye, held on November 6, it was decided to approach the Board of Agriculture and the Development Commissioners with regard to the foundation of a research institution for fruit-growing, including the practical treatment of plant diseases, in the County of Kent, and also to apply for a grant in aid of the proposed extension of the college buildings.

THE first meeting of the Association of Teachers of Mathematics for the south-eastern part of England will be held at Tonbridge School on Saturday, November 25, at 3 p.m., when the inaugural address will be given by the president, Dr. A. N. Whitehead, F.R.S. This meeting will be open to all who are interested in the teaching of mathematics Further information can be obtained from the honorary secretary of the association, Tonbridge School, Kent.

WE learn from *Science* that the will of Miss E. C. Woerishoffer leaves 125,000*l.* to the trustees of Bryn Mawr College, of which she was a graduate. From the same source we find that the estate of the late Mr. John S. Kennedy is even larger than has been previously announced. The share of Columbia University is 486,000*l.* New York University and the Presbyterian Board of Aid for Colleges each receive 195,000*l.*, and Robert College, Constantinople, 370,000*l.* The specific bequests, not dependent on the size of the estate, include 20,000*l.* each to Yale, Amherst, Dartmouth, Bowdoin, Hamilton, and Glasgow.

AT a Congregation of the University of Wales, held in Bangor on November 10, the following degrees were conferred, *honoris causa*:—For the degree of Doctor of Science, Prof. Conwy Lloyd Morgan, F.R.S., sometime Vice-Chancellor of the University of Bristol, and Sir William H. Preece, K.C.B., F.R.S., sometime electrician to the General Post Office. For the degree of Doctor of Laws, Dr. William Thomas Edwards, J.P., and Sir Isambard Owen, Vice-Chancellor of the University of Bristol, sometime Senior Deputy Chancellor of the University of Wales. For the degree of Master of Arts, Miss Isabella Cleghorn, distinguished for her services in the cause of education.

"THE Moral Influence of a University Pension System" forms the subject of an article in *The Popular Science Monthly* for November by Dr. Henry S. Pritchett. It will be remembered that the author is president of the Carnegie Foundation for the Advancement of Teaching, which has provided for the staffs of American universities and colleges a liberal scale of retiring pensions. Although the system has been organised on a non-contributory basis, Dr. Pritchett seems, on the whole, inclined to favour the contributory system. Probably the conditions are somewhat different in America from those prevailing in this country, where Government old-age pensions have been arranged on a non-contributory basis, and where the main reason for not adopting the same course in our universities has been on financial grounds.

THE present session is the thirtieth during which the City of Bradford Technical College has been at work. The new calendar, which has been received, gives full particulars concerning the very complete provisions which have been made to provide technical instruction in connection with the various industries of the West Riding. The buildings have been greatly extended in recent years. Among other important developments we notice the dye-house is now ready in which the material required for, and produced in, the textile department will be dealt with. The equipment is such that students will have the opportunity of carrying out practical work of an instructive character. The machinery is capable of dealing with loose wool or cotton, slubbing, yarns of all materials, warps, and piece goods. The machines represent the latest practice. In connection with the extension, it was decided to put down a plant for the engineering department which, although primarily intended for educational purposes, would at the same time serve for supplying light and power to the present building, the new extensions, and the school of art. This is probably the most important step in the history of the department which has yet been taken. We notice also that a systematic course in sanitary science, suitable for sanitary and other inspectors in the West Riding, has been arranged to comply with the requirements of the Sanitary Inspectors' Examination Board, and that the college has been placed by the Board of Trade on the list of technical institutions recognised by the Board for the purpose of the regulations relating to the examinations for engineers in the mercantile marine.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 9.—Sir Archibald Geikie :.C.B., president, in the chair.—Sir William **Crookes**: 'he spectrum of boron. The physical properties of the lement boron are almost unknown, notwithstanding the fforts of many chemists who have worked on the subject. Ioissan, who came nearest to obtaining the pure element, nly succeeded in getting it in the form of an amorphous owder. He said it was not possible to melt or volatilise t in a carbon crucible or arc as it was changed into carbon oride, and concluded that boron passed from the solid to he gaseous state without becoming liquid. Recently Dr. Veintraub, of the General Electric Company, U.S.A., has ot only obtained boron in a state of purity, but has preared it in a fused homogeneous state. His process onsists in running an alternating-current arc between vater-cooled copper electrodes in a mixture of boron hloride vapour with a large excess of hydrogen. The oron agglomerates on the ends of the electrodes, where t grows in the form of small rods. After a while the arc uns between two boron electrodes; and if the current is of roper value the rods melt down to boron beads, which ventually fall off, whereupon the same process repeats tself. The first specimens received from Dr. Weintraub vere deposited from a vaporous state from boron chloride nd hydrogen in the manner described. Subsequently he indly sent the author some lumps of fused boron which ad been prepared from magnesium boride. This boride issociates at a relatively low temperature (1200°), especilly *in vacuo*, and with rapidity at 1500°. The fusion is ffected between copper electrodes, the affinity of copper or boron being so slight that it can be directly fused on o the electrode without being contaminated with copper. nother way of fusing boron is in what Dr. Weintraub alls a mercury arc furnace, based on the fact that most efractory bodies, such as tungsten, tantalum, boron, &c., ave no affinity whatever for mercury. The result of the uthor's work on boron is to show its photographed specrum consists essentially of three lines, the wave-lengths of which, according to accurate measurements, are 3451·50, 497·83, and 2496·89. For more easy comparison the wavengths of these lines measured by different observers are iven below in a tabular form:—

Hartley (1883)	3450·3	2497·0	2496·2
Rowland (1893)	—	2497·821	2496·867
Eder and Valenta (1893) ...	3451·3	2497·7	2496·8
Exner and Haschek (1897) ..	3451·4	2497·8	2496·88
,, ,, (1902)...	3451·49	2497·79	2496·87
Hagenbach and Konen (1908)	3451	2498	2497
Crookes (1911)	3451·50	2497·83	2496·89

'he fourteen other lines given by Eder and Valenta, and ne five other lines given by Exner and Haschek, failed to ecord themselves on the photographs, notwithstanding xcessively long exposures given in the attempt to bring ut additional boron lines. The most interesting property f solid boron is its extraordinary rise in electric conuctivity with a slight increase in temperature. A piece f melted boron measured by Dr. Weintraub, which at ne room temperature (27°) had a resistance of 5,620,000 hms, dropped to 5 ohms at a dull red heat. Another oteworthy property of melted boron is extreme hardness. t comes next to the diamond in hardness, a splinter easily cratching corundum. Its fracture is conchoidal, and no ecided crystalline structure is seen under the microscope. 'he agglomerated boron deposited in the arc from boron hloride and hydrogen is, on the contrary, highly crystalne.—Hon. R. J. **Strutt**: A chemically active modificaon of nitrogen produced by the electric discharge: II.) Oxygen destroys active nitrogen, but does not combine ith it. Hydrogen has no action. (2) Active nitrogen, in acting with nitric oxide to form the peroxide, gives the ame greenish-yellow flame with continuous spectrum which nay be obtained by stimulating oxides of nitrogen in other 'ays. (3) The reaction just mentioned is used to deterine the percentage of active nitrogen present in ordinary itrogen as it leaves the discharge. The result found is bout 2·5 per cent., much higher than was formerly supbsed. (4) When dilute phosphorus vapour is introduced ito glowing nitrogen it does not react at once. It is not until some time after the glow has completely disappeared that the nitrogen gets into a state in which it can react with phosphorus. (5) The glow has a large electrical conductivity, comparable with that of a salted Bunsen flame. The ions are liberated in the glow, not merely carried forward from the original discharge. This ionisation is, as a rule, not very greatly affected when the spectra of other substances, such as metals or cyanogen, are developed by the active nitrogen in the space between the testing electrodes. (6) None of these spectra are visibly diminished in intensity when large electromotive forces are applied to remove the ions. (7) Ozone can in some cases develop metallic spectra when mixed at comparatively low temperatures with the metallic vapour.—Sir J. **Dewar**: Production of solid oxygen by the evaporation of the liquid.—Sir J. **Dewar** and Dr. H. O. **Jones**: The gaseous condensable compound, explosive at low temperatures, produced from carbon disulphide vapour by the action of the silent electric discharge: II.—Dr. T. H. **Havelock**: Optical dispersion: a comparison of the maxima of absorption and selective reflection for certain substances. This paper contains a discussion of various wave-lengths associated with each dominant region in a general type of dispersion formula. It is shown how the maxima of absorption and of selective reflection are, in general, separated from each other and from the wave-length corresponding to the natural vibrations in the molecule. Formulæ are obtained for some of these maxima in terms of the constants of the dispersion formula, and are confirmed by comparison with available experimental results. To estimate the magnitude of the differences in question, a numerical study is made of regions of selective absorption and reflection for carbon disulphide, rock salt, and sodium vapour; in particular, for rock salt it appears that the maximum of selective reflection in the infra-red is displaced considerably from the maximum of absorption and from the dominant wave-length of the dispersion formula. —Dr. T. H. **Havelock**: The influence of the solvent on the position of absorption bands in solutions. According to Kundt's rule, the effect of the solvent is to displace the absorption bands further to the longer wave-lengths the greater the refractive or dispersive power of the solvent. By using a suitable type of dispersion formula this rule is given a definite theoretical expression, and various experimental results are examined from this point of view. Although effects are complicated, in general, by molecular changes, it is possible to estimate in some cases how much can be ascribed to the operation of Kundt's rule.—Prof. F. G. **Donnan** and Dr. J. T. **Barker**: An experimental investigation of Gibbs's thermodynamic theory of interfacial concentration in the case of an air-water interface. The "surface" concentration of a dissolved substance in excess over that in the bulk of the solution is given by Gibbs's equation $\Gamma = -d\sigma/d\mu$, where Γ = excess of solute per unit of interface, σ = interfacial tension, μ = chemical potential of solute. Assuming the simple osmotic law of van 't Hoff for the solution, the above equation can be written in the form $\Gamma = -\frac{c}{RT}\frac{d\sigma}{dc}$, where c = bulk concentration of solute. The authors have tested this equation by measuring independently Γ, c, and $d\sigma/dc$ for the case of an air-water interface. The substances examined were pelargonic acid and saponin. The value of Γ was determined by finding the change in concentration of a given volume of solution caused by bubbling through it a known volume of air in the form of a known number of very small air bubbles. Steady streaming of the liquid was prevented by breaking up the column of liquid into a number of eddy chambers. The extremely small changes of concentration thus produced in excessively dilute solutions were measured by means of a dropping pipette, the same apparatus being also employed to measure $d\sigma/dc$. The values of the two members of Gibbs's equation were found to be in fairly good agreement, considering the difficulty of the experiments. In the case of aqueous solutions of pelargonic acid of concentrations varying between 0·008 and 0·0024 gram per 100 grams of water, the average value of Γ found experimentally was in round numbers one ten-millionth of a gram per square centimetre of interface at 15° C. In the case of saponin the values found were somewhat greater.

Zoological Society, October 24.—Sir John Rose Bradford, K.C.M.G., F.R.S., vice-president, in the chair.—Bruce F. **Cummings**: Distant orientation in Batrachia, based on observations and experiments made by the author in North Devon. Two species of newts had been used for the experiments, and the results obtained lent support to the hypothesis that these batrachians possessed a homing faculty, but no very definite instinct for detecting water, even from a short distance. Of the factors discussed in connection with amphibian migration, it was suggested that in regard to newts a combination of their homing faculty and their marked tendency to walk downhill was chiefly of assistance to them in finding water in which to breed.—Oldfield **Thomas**: Mammals collected in the provinces of Sze-chwan and Yunnan, western China, by Mr. Malcolm Anderson, for the Duke of Bedford's exploration of eastern Asia. The paper formed No. xv. of the series, and would be the last on Mr. Anderson's specimens, as he was now returning finally to America. During his work on the exploration he had obtained 2700 specimens, besides many birds, and had quite revolutionised our knowledge of the area explored. The present collection, given, as before, to the National Museum by the society's president, consisted of 160 specimens, belonging to thirty-three species.—E. P. **Stebbing**: Game sanctuaries and game protection in India. The author discussed the question of the formation of game sanctuaries and what had been already done in this direction in various parts of the country. Suggested additions to the proposed New Indian Game Act were given, and "close seasons" for certain species recommended as being necessary for the preservation of the game of the country.

Challenger Society, October 25.—Dr. G. H. Fowler in the chair.—Prof. D'Arcy W. **Thompson**: The scales of the herring as an index to age. In the herring, the rings or zones borne by the scales, which are constant in number for the same individual, and are undoubtedly correlated in some way with the size and age of the fish, are not, in the writer's opinion, so simply related to the years of life that the age of an individual fish can be determined with accuracy from an inspection of the scales. In any random sample of herring the frequencies of individuals at centimetre lengths and of numbers of rings each forms a probability curve grouped about a single mode. Either, then, the shoal is composed of herrings of uniform age and number of rings, or of various ages and ring numbers mixed in a definite and remarkable manner. While, on the usual hypothesis of each scale ring indicating a year of life, the facts may conceivably be explained as due to selective action of the net, the writer considers that it is more probable that the members of a herring shoal are of the same age.—Dr. W. T. **Calman**: Phototropism and the distribution of marine organisms (opening of discussion).

British Psychological Society, November 4.—Dr. Beatrice **Edgell** and W. Legge **Symes**: A preliminary note on visual flicker.—Dr. F. **Golla**: The vestibule and the concept of space.—J. **Kay**: (1) Apparatus for McDougall's dotting test; (2) apparatus for weight discrimination.

Mathematical Society, November 9.—Dr. H. F. Baker, president, in the chair.—J. E. **Campbell**: The invariants of the linear partial differential equation of the second order in two independent variables.—Colonel R. L. **Hippisley**: Closed linkages.—H. **Hilton**: Invariants of a canonical substitution.—G. T. **Bennett**: The system of lines of a cubic surface.—G. H. **Hardy** and J. E. **Littlewood**: The relations between Borel's and Cesàro's methods of summation.

CAMBRIDGE.

Philosophical Society, October 30.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—G. R. **Mines**: Note on the mode of discharge of the Cuverian organs of *Holothuria nigra*. The sea-cucumber, *H. nigra*, when irritated emits white conical bodies, the Cuverian organs, which rapidly elongate, shooting through the water while remaining attached at their bases to the animal, and forming long, intensely sticky tubes. These are then disconnected from the animal. The elongation of the Cuverian organs has been attributed to internal water pressure by some, but by others to an intrinsic activity of the t[...] The former view is strongly supported by the facts [pre]sented in this communication. Undischarged Cuv[...] organs removed from the body cavity of Holothuria can [be] made to elongate in a manner exactly resembling [the] normal discharge by injecting them with sea water or o[ther] fluid. The natural discharge of the Cuverian organ[s is] always preceded and accompanied by a rise in the pre[ssure] within the body of the animal, and this pressure re[...] the value needed to elongate an excised Cuverian or[gan]. The arguments which have been adduced in favour of [the] intrinsic activity of the Cuverian organs are shown, [by] further experiments, to lack cogency. An account of [the] work will appear shortly in *The Quarterly Journal [of] Microscopical Science*.—Oswald H. **Latter**: The discha[rge] of spermatozoa by *Unio pictorum*.

PARIS.

Academy of Sciences, November 6.—M. Armand Gaut[ier] in the chair.—E. H. **Amagat**: The internal pressure [of] fluids and the determination of the absolute zero. In [a] previous paper the author has defined a function π = $\left(T\frac{dp}{dt}-p\right)$. It is now shown that the values of π f[or] hydrogen, taken for pressures of 1 and 3 atmospheres, an[d] taking 273 as the temperature of melting ice on the ab[so]lute scale, obey perfectly the law of the square of th[e] volume, and this is not the case if 273·1 or 272·9 [is] assumed. It is possible to look at the problem from [a] different point of view, and determine the absolute zer[o] from the condition that, starting with well-determ[ined] coefficients of pressure under 1 and 3 atmospheres, th[e] values of π should rigorously satisfy the law of the squ[are] of the volume. This gives from the data for hydrog[en] 272·983, for nitrogen 272·999, and for oxygen 272·996 f[or] the absolute zero.—C. **Guichard**: A very extended class [of] triple orthogonal systems.—J. **Meunier**: The conditions [of] production of the Swan spectrum, and on conclusions wh[ich] may be drawn relating to comets which possess this spe[c]trum. The Swan spectrum is regarded as essentially [a] spectrum of oxidation and explosive combustion, and ad[di]tional experiments on this point are described. The Sw[an] spectrum denotes not only the presence of a hydrocarbo[n] but also that of oxygen, and hence oxygen must be pre[sent] in comets showing this spectrum.—A. **Guillet**: An ind[uc]tion-coil interrupter formed of a primary arc.—J. **Guyot**: The differences of contact potential apparent between metal and electrolytic solutions.—Jacques **Danne** [and] Victor **Crémieu**: The quantity of radium emanation di[s]engaged by one of the springs at Colombières-sur-Or[b], Hérault. The amounts of emanation per 10 litres of g[as] have been determined for three springs. One of the[se], the Crémieu spring, is remarkable on account of the lar[ge] quantity of gas spontaneously evolved—43,000 litres [in] twenty-four hours. The amount of emanation disengage[d] in twenty-four hours from this spring is more than doub[le] that of Ax (Viguerie); and, moreover, since 95 per cen[t.] of the gas from the Crémieu spring is carbon dioxide, t[he] concentration in the radium emanation is readily increa[sed] twenty times by simple treatment with alkaline solution. —G. Ter. **Gazarian**: A general relation between t[he] physical properties of bodies: application to densit[ies]. The comparison of physical properties, either at 0° C., [or] at the boiling point, or at corresponding temperatur[es] according to Van der Waals's formula, is not altogeth[er] satisfactory; and in place of these the author proposes t[he] following: at temperatures equally removed from t[he] critical temperatures, the quotients of the numbers r[e]presenting a property for any two bodies whatever are [a] linear function of the temperature. This holds for d[ensi]ties, viscosity coefficients, surface tension, the rectilin[ear] diameter of Cailletet and Mathias, and the latent heat [of] vaporisation. The densities were compared at analog[ous] temperatures (defined as above) of ammonia and pentan[e], carbon monoxide and pentane, benzene and pentane, acet[ic] acid and pentane.—H. **Duval**: The molecular refraction [of] azo-compounds. The molecular refraction of solutions [of] azo-benzene was found to depend to a certain extent on t[he] solvent. The ortho- or meta-position of a substitut[ing] group causes too slight a variation in the refraction

[co]nclude that these compounds have a different constitu[tio]n.—A. **Boutaric**: Cryoscopy in fused sodium thio[sul]phate. $Na_2S_2O_3.5H_2O$ melts at 48·5° C. The tempera[tu]re of equilibrium between the solid hydrates with $5H_2O$ [an]d $2H_2O$ and the solution is 48·2° C. Various organic [su]bstances and salts of sodium give a molecular lowering [i]n this solvent of 44°; salts of other metals produce about [do]uble this lowering.—A. **Besson**: The formation of [hy]drogen peroxide under the silent electric discharge. It [is] proved that H_2O_2 can be formed by the silent discharge [act]ing on moist rarefied air at a moderately low tempera[tur]e, conditions realised in the upper regions of the atmo[sp]here. Although ultra-violet light may be one cause of [th]e presence of hydrogen peroxide in rain water, these [ex]periments prove that electrical phenomena may also be [a] contributory cause.—J. **Bougault** and C. **Charaux**: [La]ctarinic acid. This acid has been shown in a previous [pa]per to be a ketostearic acid. The application of the [Be]ckmann reaction proves the ketonic group to be in the [po]sition 6, the formula being

$$CH_3—(CH_2)_{11}—CO—(CH_2)_4—CO_2H.$$

—J. B. **Senderens** and J. **Aboulenc**: The catalytic [es]terification of the dibasic acids in the wet way. Quanti[ta]tive studies of the formation of esters of malonic, [su]ccinic, oxalic, and phthalic acids in presence of small [qu]antities of sulphuric acid, aluminium sulphate, or [po]tassium bisulphate as catalysts.—A. **Roussy**: The life [of] fungi in the fatty acids. It is shown that moulds which [gr]ow well in a medium containing a certain quantity of [fa]t owe their development rather to the fatty acids than to [th]e glycerol. It is only in rare cases, in particular for [As]pergillus and Penicillium, that glycerol is as good a [me]dium as the fatty acids.—Raoul **Combes**: Researches [on] the formation of the anthocyanic pigments.—J. [Du]**mont**: A new method for the physical analysis of soil. —Louis **Gaucher**: The digestion of casein. Milk is only [co]agulated in the stomach, and the clots reduced to a fine [st]ate of division by the contractions of this organ. The [pe]ptonisation occurs in the intestine, and may even be [co]ntinued in the duodenum. The coagulation of the milk [in] the stomach is not a necessary condition of its digestion. —F. **Houssay** and A. **Magnan**: The wing surface, the [we]ight of the pectoral muscles, and the feeding process in [ce]rtain birds.—A. **Desgrez**: The influence of the chemical [co]nstitution on the toxicity of nitriles and amides. Un[sa]turated nitriles are more toxic than saturated nitriles [co]ntaining the same number of carbon atoms.—E. [Vo]**isenet**: New considerations on the disease of bitterness [in] wines in its relations with the acrylic fermentation of [gly]cerol. The acrylic fermentation of glycerol is at least [on]e of the essential processes undergone by wine when it [de]velops bitterness.—A. **Daniel-Brunet** and C. **Rolland**: [Co]ntribution to the chemical and physiological study of [th]e hepatic gland in cattle.—P. **Mazé**: Experimental [ch]lorosis in maize.—Raphaël **Dubois**: Microbioids.—M. [Fo]**urnier**: The existence of coal at Franche-Comté, at [Sa]int Germain near Lure (Haute-Saône). Details are [gi]ven of the strata found in three trial borings; the coal [fo]und is similar to the Ronchamp coals.—L. **Cayeux**: [Th]e existence of organic remains in the ferruginous rocks [as]sociated with the Huronian iron minerals in the United [St]ates.

BOOKS RECEIVED.

[A]ccount of the Operations of the Great Trigonometrical [Su]rvey of India. Vol. xix. Levelling of Precision in [In]dia (1858–1909). By Col. S. G. Burrard, F.R.S. Pp. [v]i+484+xviii plates. (Dehra Dun: Office of the [Tr]igonometrical Survey of India.) Rs. 10.8.

An Introductory Course of Mechanics and Physics for [Te]chnical Students. By W. M. Hooton and A. Mathias. [Pp]. vii+148. (London: W. B. Clive.) 1s. 6*d*.

Kulturpflanzen und Haustiere in ihrem Übergang aus [As]ien nach Griechenland und Italien sowie in das übrige [Eu]ropa. Historisch-Linguistiche Skizzen von V. Hehn. [Ac]hte auflage neu herausgegeben von O. Schrader. Mit [bo]tanischen beiträgen von A. Engler und F. Pax. Pp. [x]viii+665. (Berlin: Gebrüder Borntraeger.) 17 marks.

The Home-life of the Osprey. Photographed and de[sc]ribed by C. G. Abbott; with some photographs by H. H. Cleaves. Pp. 54 and 32 mounted plates. (London: Witherby and Co.) 6*s*. net.

Treatise on Practical Light. By Dr. R. S. Clay. Pp. xv+519. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

The Rubber-planter's Notebook. Compiled from the most reliable and modern sources by F. Braham. Pp. viii+108. (London: Crosby Lockwood and Son.) 2*s*. 6*d*. net.

The Story of the Zulus. By J. Y. Gibson. New edition, revised and extended. Pp. vii+338. (London: Longmans and Co.) 7*s*. 6*d*.

The Life of Paracelsus, Theophrastus von Hohenheim, 1493–1541. By A. M. Stoddart. Pp. xv+309. (London: Murray.) 10*s*. 6*d*. net.

Land and Peoples of the Kasai: being a Narrative of a Two Years' Journey among the Cannibals of the Equatorial Forest and other Savage Tribes of the South-western Congo. By M. W. Hilton-Simpson. Pp. xx+356. (London: Constable and Co., Ltd.) 16*s*. net.

Pflanzengeographische Wandlungen der deutschen Landschaft. By Prof. H. Hausrath. Pp. vi+274. (Leipzig: Teubner.) 5 marks.

Chemisch-technisches Praktikum. By Dr. W. Moldenhauer. Pp. vii+206. (Berlin: Gebrüder Borntraeger.) 6.80 marks.

Handbuch der vergleichenden Physiologie, herausgegeben von H. Winterstein. Sechzehnte Lieferung. Band iv. Erste Hälfte. Pp. 321–480. (Jena: Fischer.) 5 marks.

Physiology. By Prof. W. D. Halliburton, F.R.S. Pp. xi+176. (London: J. M. Dent and Sons, Ltd.) 1*s*. net.

Roses. By H. R. Darlington. Pp. xiii+193. (London: T. C. and E. C. Jack.) 2*s*. 6*d*. net.

Gardens Shown to the Children. By J. H. Kelman and O. Allen. Described by J. A. Henderson. Pp. xii+100. (London: T. C. and E. C. Jack.) 2*s*. 6*d*. net.

The British Bird Book. Edited by F. B. Kirkman. Section vi. Pp. 379–540. (London: T. C. and E. C. Jack.) 10*s*. 6*d*. net.

In Northern Mists. Arctic Exploration in Early Times. By Prof. F. Nansen, G.C.V.O. Translated by A. G. Chater. Vol. i. Pp. xi+384. Vol. ii. Pp. iii+416. (London: Heinemann.) Two vols. 30*s*. net.

Through Trackless Labrador. By H. H. Prichard. With a chapter on Fishing by G. M. Gathorne-Hardy. Pp. xv+254. (London: Heinemann.) 15*s*. net.

Pictures of British History. By E. L. Hoskyn. Pp. 64. (London: A. and C. Black.) 1*s*. 6*d*.

Year Book of the Indian Guild of Science and Technology, 1911. Pp. 135. (Letchworth: The Letchworth Printers, Ltd.)

The Canadian Rockies: New and Old Trails. By Prof. A. P. Coleman, F.R.S. Pp. 383. (London: T. Fisher Unwin.) 12*s*. 6*d*. net.

A Text-book of Physiological Chemistry. By Prof. O. Hammarsten. Authorised translation from the author's enlarged and revised seventh German edition by Prof. J. A. Mandel. Sixth American edition. Pp. viii+964. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 17*s*. net.

Tables of Physical and Chemical Constants and some Mathematical Functions. By Dr. G. W. C. Kaye and Prof. T. H. Laby. Pp. vi+153. (London: Longmans and Co.) 4*s*. 6*d*. net.

Rifle, Rod, and Spear in the East, being Sporting Reminiscences. By Sir E. Durand, Bart. Pp. xi+200. (London: Murray.) 8*s*. net.

Fourth Scientific Report on the Investigations of the Imperial Cancer Research Fund. By Dr. E. F. Bashford. Pp. xxi+223. (London: Taylor and Francis.)

The Elements of Plane and Spherical Trigonometry. By J. G. Hunt and C. R. MacInnes. Pp. vii+205. (London: Macmillan and Co., Ltd.) 6*s*. net.

Dairy Cattle and Milk Production. By Prof. C. H. Eckles. Pp. xii+342. (London: Macmillan and Co., Ltd.) 7*s*. net.

Beginnings in Agriculture. By A. R. Mann. Pp. xii+341. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

The Conquest of Nerves. By Dr. J. W. Courtney. Pp. v+209. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

The Learning Process. By Prof. S. S. Colvin. Pp.

xxv+336. (London: Macmillan and Co., Ltd.) 5s. 6d. net.

Experiments in Educational Psychology. By Dr. D. Starch. Pp. vii+183. (London: Macmillan and Co., Ltd.) 4s. net.

The Theory and Practice of Technical Writing. By Prof. S. C. Earle. Pp. vii+301. (London: Macmillan and Co., Ltd.) 5s. 6d. net.

The Elements of Electrical Transmission. By Prof. O. J. Ferguson. Pp. vii+457. (London: Macmillan and Co., Ltd.) 15s. net.

A Text-book of Inorganic Chemistry. By Dr. G. Senter. Pp. xi+583. (London: Methuen and Co., Ltd.) 6s. 6d.

Outlines of Biology. By Dr. P. C. Mitchell, F.R.S. Third edition. Revised and supplemented by G. P. Mudge. Pp. xv+348. (London: Methuen and Co., Ltd.) 6s. net.

L'Équation de Fredholm et ses Applications à la Physique Mathématique. By Profs. H. B. Heywood and M. Fréchet. Pp. vi+165. (Paris: A. Hermann & Fils.) 5 francs.

Introduction à la Théorie des Équations Intégrales. By Prof. T. Lalesco. Pp. vii+152. (Paris: A. Hermann & Fils.) 4 francs.

Traité de Chimie Générale. By Prof. W. Nernst. Ouvrage traduit sur la 6e édition allemande by Prof. A. Corvisy. Deuxième Partie. Pp. 422. (Paris: A. Hermann & Fils.) 10 francs.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—On the Discovery of a Novel Type of Flint Implements below the Base of the Red Crag of Suffolk, proving the Existence of Skilled Workers of Flint in the Pliocene Age: Sir Ray Lankester, K.C.B., F.R.S.—Studies in Heredity. I. The Effects of Crossing the Sea-urchins (*Echinus esculentus* and *Echinocardium cordatum*): Prof. E. W. MacBride, F.R.S.—The Influence of Ionised Air on Bacteria: Prof. W. M. Thornton.—The Intrinsic Factors in the Act of Progression in the Mammal: Dr. T. G. Brown.—The Refractive Indices of the Eye Media of some Australian Animals: Dr. J. L. Jona.—The Permeability of the Yeast Cell: S. G. Paine.—Ventilation of the Lung during Chloroform Narcosis: G. A. Buckmaster and J. A. Gardner.—(1) On the Boiling Point of Water; and (2) on the Boiling Points of some saturated Aqueous Solutions: Lord Berkeley, F.R.S., and M. P. Appleby. (*Published.*)—The Heating Effect of the Currents in Precise Measurements of Electrical Resistance: Dr. R. T. Glazebrook, F.R.S., W. R. Bousfield, and F. E. Smith. (*Published.*)

INSTITUTION OF MINING AND METALLURGY, at 8.—*Adjourned Discussions:* (1) Fallacies in the Theory of the Organic Origin of Petroleums: Eugene Coste; (2) The Economics of Tube-milling: H. Standish Ball. —*Paper:* The Whim Well Copper Mine, West Pilbara, North-west Australia: H. R. Sleeman.

LINNEAN SOCIETY, at 8.—Recent Researches on Œnothera: Dr. R. R. Gates.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Endurance of Metals: Experiments on Rotating Beams at University College, London: E. M. Eden, W. N. Rose, and F. L. Cunningham. (*Adjourned Discussion.*) —*Probable Paper:* Double-cutting and High-speed Planing Machines: J. Hartley Wicksteed.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Notes on the Design of Motor-car Headlights: Dr. H. R. B. Hickman.

MONDAY, NOVEMBER 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Volcanic Craters and Explosives: Dr. Tempest Anderson.

TUESDAY, NOVEMBER 21.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* The Loch Leven Water-power Works: A. H. Roberts.—The Hydro-electric Plant in the British Aluminium Company's Factory at Kinlochleven: F. B. Sonnenschein.

ZOOLOGICAL SOCIETY, at 8.30.—The Fresh-water Crayfishes of Australia: Dr. Geoffrey Smith.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. III. On a New Genus of Tapeworms from the Bustard (*Eupodotis kori*): F. E. Beddard, F.R.S.—Structure of the Alimentary Canal of the Stick Insect (*Bacillus rossii*, Fabr.), with a Note on the Parthenogenesis of this Species: A. E. Cameron.—Some Remarks on the Habits of British Frogs and Toads, with reference to Mr. Cummings's recent communication on "Distant Orientation in Amphibia": G. A. Boulenger, F.R.S.—Diagnoses of New Species of Terrestrial and Fluviatile Snells from British and German East Africa: H. B. Preston On the Milk-Dentition of the Ratel: R. Lydekker, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.—The Course of Prices at Home and Abroad, 1890–1910: R. H. Hooker.

WEDNESDAY, NOVEMBER 22.

ROYAL SOCIETY OF ARTS, at 8.—The Industrial Progress of the United States of America: Dr. James Douglas.

GEOLOGICAL SOCIETY, at 8.—Petrological Notes on Guernsey, Herm, Sark, and Alderney: Prof. T. G. Bonney, F.R.S., and the Rev. Edwin Hill. —The Evolution of Inoceramus in the Cretaceous Period: H. Woods.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Iron Flame Spectrum and those of Sun-spots and Lower-type Stars: Sir N. Lockyer, K.C.B. F.R.S.—Sinhalese Iron and Steel of Ancient Origin: Sir R. A. H[...] F.R.S.—On the Conductivity of a Gas between Parallel Plate El[...] when the Current approaches the Maximum Value: Prof. J. S. Tow[...] F.R.S.—Spectroscopic Investigations in connection with the Active [...]fic tion of Nitrogen. II. Spect[...] of Elements and Compounds ex[...] the Nitrogen: Hon. R. J. Stru[...] F.R.S., and Prof. A. Fowler, F[...] The Less Refrangible Spectr[...] of Cyanogen, and its Occurren[...] Carbon Arc: Prof. A. Fowl[...], F.R.S., and H. Shaw.—Note [...] Monatomicity of Neon, Kryp[...]n, and Xenon: Sir W. Ramsay, K[...] F.R.S.—The Adherence of Plain Surfaces: H. M. Budgett. [...] Resistance to the Motion of a Thread of Mercury in a Glass Tube: G[...] West.—The Distillation of Binary Mixtures of Metals in vacuo, [...] Isolation of a Compound of Magnesium and Zinc: A. J. Berry.—A[...] of Tidal Records for Brisbane for the Year 1908: F. J. Selby.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Re[...] Battery Boosters: R. Rankin.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Huxley Me[...] Lecture.—The Early Inhabitants of Western Asia: Prof. F. von L[...]

INSTITUTION OF MINING AND METALLURGY, at 8.—The Develop[...] the Copper Queen and the Warren Mining District: Dr. James [...]

CHEMICAL SOCIETY, at 8.30.—*Extra Meeting.*—Prof. Harold B. D[...] F.R.S., will deliver the Berthelot Memorial Lecture.

FRIDAY, NOVEMBER 24.

PHYSICAL SOCIETY, at 5.—The Maximum Value of the Electric [...] between Two Unequal Spherical Electrodes: Dr. A. Russell.[...] Cubical Expansion of Fused Silica: F. J. Harlow.—On the Tem[...] Coefficient of Diffusion: B. W. Clack.—The *a* Particles emitted [...] Active Deposits of Thorium and Actinium: E. Marsden and T. Ba[...] —The Magnetic Transition Point of Cementite: S. W. J. S[...] W. White, and S. G. Barker.

CONTENTS.

PA[GE]

THURSDAY, NOVEMBER 23, 1911.

HUMAN GEOGRAPHY.

Influences of Geographic Environment. On the Basis of Ratzel's System of Anthropo-Geography. By Ellen C. Semple. Pp. xvii+683. (New York: Henry Holt and Co.; London: Constable and Co., Ltd., 1911.) Price 4.00 dollars net.

THE influence of geology on that part of geography which deals especially with the forms of the earth's surface, and of mathematics on the measurement and representation of that surface, have given a definiteness and precision to the inorganic side of the subject which are less evident in the geographical study of man and of his relations to the region in which he dwells. In German the work of Ratzel has long furnished a basis for the scientific development of this part of the subject, and though his "Anthropologie" is rather a collection of brilliant essays than a logical and even treatment of this vast subject, its influence on subsequent workers has been far-reaching. In English such treatment of the subject in a scientific manner on a like scale has not been attempted, and the organic side of geography has been delayed in its scientific development here by its absence. Miss Semple's volume is therefore particularly valuable, especially as it is not simply a restatement of the principles embodied in Ratzel's work but comprises such amplification of some portions and abridgment of others as were necessary to make a more even presentation of the subject; at the same time as much evidence as possible of typical peoples of all races and all stages of cultural development living under similar geographical conditions has been incorporated.

A short account of geographical factors and influences serves as an introduction to the subject, in which the continuous operation of geographical conditions on man is shown, and their importance in the history of peoples is emphasised. These influences are classified into the physical effects of environment; the psychical effects, which are bound up in many physiological modifications, and help to differentiate peoples and races in point of temperament; the economic and social effects; and, lastly, the influence of the features of the earth's surface in directing the movements and the ultimate distribution of mankind. From this general statement of the scope of the subject illustrated by numerous instances from the history of peoples of all stages of development we pass to the results of environment as seen in general location; here the relations of a society or state to the land come first, since in geography a human group is not conceivable apart from the land on which it dwells.

Such considerations lead naturally to the more definite treatment of the geographical significance of environment in the bearings of geographical location, the influence of geographical area on its inhabitants, and the various types of geographical boundaries which exist. The examples which support and illustrate the treatment of these subjects are drawn from primitive races, semi-civilised peoples, and the civilised nations, from the races of the past as well as of the present, so as to show the importance of taking into account the stage of culture and world-relations when drawing deductions from the facts of geographical environment. The aspects of specific location are next discussed, and the part played by seas and oceans, rivers and lakes, by continents and islands, plains and deserts, mountain barriers and their passes is explained as influencing the distribution, development, and movement of the peoples inhabiting them. The people of the coast, island races, and mountain tribes are thus investigated in order to show the effects which have been produced on them by their environment.

In this way and with the aid of a full bibliography at the end of each chapter a very large amount of information relating to the influence of the earth's surface on its population has been collected and presented in a very convenient form. Definitions and systematic classification have been avoided intentionally from the conviction that the subject is being but gradually evolved, and has not yet reached a stage at which such can be usefully introduced, but some provisional efforts in this direction would have assisted the geographer who avails himself of the mass of material here provided and the original works to which he is referred. Precise description and quantitative treatment by recognised scientific method is much needed in this branch of geography, and Miss Semple has placed English-speaking geographers under a deep obligation by her scholarly treatment of the influences of geographical environment. It is for them now to carry forward the investigation into specific instances in order to determine the value of the different factors involved in each case, so that human geography may be as precise and definite in its methods and its results as the physical branch of the subject. To this end accurate and well-designed maps are of great assistance in representing the distribution of data, and we must regret that most of those in the present work are not satisfactory; the drawing is coarse and the scale is indicated by the lines of latitude and longitude only. Printed on suitable paper line blocks give excellent results, and looking at those which illustrate German text-books on this and other subjects, it is to be desired that they should be employed here to better advantage.

THE AMERICAN AND COUNTRY LIFE.

The Country-life Movement in the United States. By Prof. L. H. Bailey. Pp. xi+220. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* 6*d.* net.

TO the untravelled Englishman, who still looks upon money-making and hustling as the natural habit of the American, the steady outflow of books from the United States dealing with the country and with country life comes as a great surprise. But those who have had the privilege of meeting the American in real life know that he, too, like the Englishman, has an inborn love of the country, which has not been killed off even by a couple of generations of town life, and is now asserting itself more than at any time in our previous history. Indeed, this

conscious love of country life so often (and sometimes so mawkishly) expressed, is perhaps one of the most significant of modern characteristics.

Two factors play a highly important part in the movement: the purely personal factor, a desire on the part of the individual to get away from the artificiality of the city into the green fields and the woods, and the social factor, a realisation that only by making the most of our natural resources and getting the greatest possible produce out of the land can the community be established on a sound basis. We may thus roughly divide the literature of the subject under two main headings. Several of Prof. Bailey's books deal with the second aspect of the problem; in the present he takes a complete survey of the whole field.

The country-life movement, he states, is the working out of the desire to make rural civilisation as effective and satisfying as any other civilisation. It is thus to be an end in itself, and not merely a way of raising more food, or of absorbing city undesirables, or increasing the price of land, although all these things may happen as secondary consequences. The Commission on Country Life appointed by President Roosevelt in 1908 was the first organised expression of the movement in the States, and it found that agriculture is not commercially as profitable as it is entitled to be, and that the social conditions of the open country are far short of their possibilities. Three great campaigns were recommended: a survey of rural resources; the organising of a nationalised extension work; and the inauguration of a general campaign of rural progress. All are, in Prof. Bailey's view, equally necessary; every rural community needs to have a programme of its own carefully worked out, and this programme should rest on a physical valuation. It is high time that this work was put in hand; much of the necessary information has been collected by the agricultural colleges, and in general men are available for carrying out these great constructive plans once they are evolved.

But some very clear thinking must first be done, and a good deal of confusion must be brushed away. Especially must we avoid one very common error—the idea that suburbanism and gardening constitute country life. It is to the development of the village, not as the suburb of a great city, but as the place where the inhabitants actually earn their livelihood, that Prof. Bailey looks for future progress. As a first step farming has to be made more profitable by eliminating non-effective charges (the middleman, according to Prof. Bailey, secures over 50 per cent. of the proceeds in some cases), and more power, political, social, and commercial, must be given to the village. Further, the village and city must not compete. "We can never again be a rural people. We want the cities to grow." But it is also necessary to impress upon the cities the fact that they stand to gain by having an efficient village society, a new social order evolved in the open country, to which every farmer must contribute his share. Whilst the tendency of the city is to make eight-hour men and clock watchers, this new society must aim higher, for its business is the struggle with nature and the conquest of the earth.

E. J. R.

ELEMENTARY METEOROLOGY.

Weather Science: an Elementary Introduction to Meteorology. By F. W. Henkel. Pp. 335. (London: T. Fisher Unwin, 1911.) Price 6s. net.

IN elementary text-books of meteorology it is the custom to begin with a description of the action of common instruments like the barometer and thermometer, and of common facts like the apparent motions of the sun, and to continue the theoretical development as far as elementary mechanics and thermodynamics. Exigencies of space prevent a complete exposition, and it is found necessary to omit explanations at some stages. Unfortunately, authors almost invariably choose the later stages for the omissions; there they give merely the bald statement of facts, with little or no explanation. It would seem desirable to omit certain introductory matters which can be found in all elementary text-books on physiography or physics, and to reserve the space for a fuller treatment of the special problems of the atmosphere. In the book before us, the author describes in detail the apparent motions of the sun, but assumes that his readers understand the term "latent heat," and gives no explanation of the effect of change of pressure on moist air.

Nevertheless, Mr. Henkel has produced an interesting and readable book. He has quoted freely from authorities such as Abercromby, Scott, Waldo, Maury, and Inwards, and has, in some cases, added paragraphs and chapters giving a description of more recent work. The additions are not all as complete as could be desired, and they usually appear to be culled from isolated books and papers, producing a somewhat fragmentary result in places. Thus, a reference is made to Simpson's new theory of thunderstorms as it appeared briefly in NATURE, but other new theories are not mentioned.

Perhaps the most serious criticism that would occur to a reader is the almost complete absence of diagrams, and more especially of charts and maps. The book is by no means free from illustrations, but they are almost entirely reserved for instruments and cloud forms, the latter being particularly good. We doubt whether a reader new to the subject would understand clearly the verbal descriptions of the distribution of mean pressure, air and sea temperatures, and ocean currents; and the explanations of Buys Ballot's Law and of the types of pressure distribution are incomplete without illustrative examples.

The author has allowed himself to build up a complete story under the general heading of each chapter, irrespective of whether a part of the story appears elsewhere in another connection. Thus, Buys Ballot's law is stated no less than three times in three different chapters. The reiteration of the fundamental law of dynamical meteorology has its advantages, but other repeated statements are open to question. Among these is one affirming that rain in mountainous districts is due to the cooling effect of the summits on the warm moist air passing over them. Meteorologists are not yet agreed as to whether a mountain peak is in general cooler than the surrounding air, but even allowing a considerable temperature difference,

the dynamical cooling due to the forced ascent of the air and consequent reduction of its pressure is a more effective rain-producing agent.

We have noted a few misprints and mis-statements, but in general the principles as stated are sound. The book is well printed on good paper, and there is a useful index; but the binding of the copy that we have has already given way.

R. C.

A GARDEN OF HERBS.

The Herb-Garden. By Frances A. Bardswell. Pp. viii+173+plates. (London: A. and C. Black, 1911.) Price 7*s.* 6*d.* net.

ONE of the most delightful charms of old English gardening must have been due to the numerous sweet-smelling and aromatic herbs that were commonly cultivated around the homesteads. The very earliest records of gardening were supplied us by the ancient herbalists who cultivated their simples for medicinal purposes or for the pretty sentiments and conceits that legend had associated with them, but there is sufficient evidence that the herbalists took pleasure in their plants for the further reason that many of them possessed the qualities of beauty and fragrance. As we read Gerarde and Parkinson or Culpepper, we seem to breathe the atmosphere of the herbalist's garden, laden as it was with the delightful perfumes of lavender, balm, rosemary, southernwood, and many other plants the names of which are scarcely known to modern gardeners, much less their distinctive qualities.

The comparative neglect of the herbs which fire the enthusiasm of the author may be traced to a feeling allied to contempt, directly due to the fact that modern medical science has exposed the fallacious character of the beliefs formerly entertained in respect to their healing qualities. The contempt was natural enough, although unscientific and illogical, as is the case with most things which are merely the results of reaction. We are only just beginning to realise that, even when it is admitted that the garden simples are not "heal-alls," yet they have a wonderful interest for those who care to study them and admit them to their gardens.

At this point Miss Bardswell's book comes to show how we may make the most of the herbs from the point of view of the decorative gardener. It convinces the reader that many of the species have claims which should entitle them to every consideration—fragrance, romance, and economic value in the kitchen, still-room, and nursery. The pictures by the Hon. Florence Amherst and Miss Forrest are a pretty feature of the volume, and they greatly assist the author in presenting her case, for they show that, if but few of the sweet herbs possess such brilliant flowers as, for example, the bergamot, nevertheless many of them are sufficiently decorative to provide charming subjects for the artist's brush. And what about their cultivation? The author gives all the information necessary for any novice who wishes to engage in their culture. There are directions for planting, propagation, harvesting, and drying, with other details. We have known many cases where herbs were given a prominent place in the garden, and every care expended on their cultivation, but they were not utilised indoors, as they might be, because there appeared to be a lack of knowledge as to the time proper for cutting them and the care they require until they are perfectly dry.

The first things to consider in the formation of a herb garden are what site to choose and what style to make the beds. The author has something to say on these matters, but she is not inclined to be rigid in her recommendations. Beyond insisting upon the necessity for sunshine, she does not lay down rules as to the form of beds, she pleads for the cultivation of the herbs and is content if they are planted in beds or in ordinary flower borders, remarking that one of the best collections of herbs she has seen was grown in a kitchen garden. For ourselves, the interest we have in the plants is partly for their fragrance but equally for the sentiment that belongs to them in the legends. Consequently we admire them most when they overlay the confined borders of the narrow and oblong beds in the old English garden, with paved paths on which the thyme and other low-growing species find homes in the soil between the flags, the whole surrounded with venerable walls supporting old-fashioned climbers, including the fragrant myrtle, honeysuckle, and other species reminiscent of a long-past age. Such a garden we saw quite recently in North Wales, where the lavender bushes were three feet high and as much through.

PHYSICAL CHEMISTRY FOR THE GEOLOGIST.

Vorlesungen über die chemische Gleichgewichtslehre und ihre Anwendung auf die Probleme der Mineralogie, Petrographie, und Geologie. By Prof. R. Marc. Pp. vi+212. (Jena: Gustav Fischer, 1911.) Price 5 marks.

IN this little volume Prof. Marc gives the substance of a course of lectures delivered at the University of Jena, dealing, as the title announces, with the theory of chemical equilibrium in its application to mineralogical and geological problems. We gather from the preface that these lectures were addressed to students not previously acquainted with the modern developments of physical chemistry. It is to be presumed that the material has undergone considerable condensation for the purpose of publication, for a student in this situation must read very closely if he is to obtain the full benefit of the book before us. He will be aided by the simplicity of the general plan, and by the author's clear method of presentation, while the numerous well-chosen references will enable him to pursue farther any particular part of the subject.

The first lecture treats of the general conception of chemical equilibrium, and the second introduces the reader to the law of mass action and the phase rule. The next two lectures deal with the conditions of equilibrium in systems of one component, the illustrations being drawn so far as possible from cases which are of importance to the geologist. Thus the dependence of melting-point on pressure is considered with special reference to the case of ice. Polymorphism

in the mineral kingdom is discussed, and a list of examples given, which might be considerably enlarged. Three lectures are devoted to two-component systems, introducing the subjects of solution and solid solution, and discussing the crystallisation of silicate-magmas of ideal binary composition. Next we come in due order to three-component systems, which are treated less fully than might be expected. The author makes a bold attempt to construct a diagram for the system silica-lime-magnesia by combining data drawn from various sources. He does not allude, except in a passing reference, to Schreinemaker's work. The important case of an aqueous solution containing several components receives due notice, and the results of van 't Hoff's researches on the crystallisation of marine salts are given at some length. A lecture on surface energy in its application to geological phenomena contains much interesting matter. Joly's work on sedimentation is not cited, but there is an account of Schade's curious researches on the oolitic structure. In the final lecture, dealing with cosmology and vulcanology, the author has permitted himself some latitude of speculation, and some of his remarks are at least open to debate.

The book will serve as a very useful guide to chemical geology. Its information is in general well up to date, though a few exceptions may be found; for instance, Shepherd and Rankin showed two years ago that the high-temperature form of silica is not tridymite but cristobalite.

A. H.

FEEBLE-MINDED CHILDREN.

(1) *The Feeble-minded: a Guide to Study and Practice.* By Dr. E. B. Sherlock. With an introductory note by Sir H. B. Donkin. Pp. xx+327. (London: Macmillan and Co., Ltd., 1911.) Price 8*s*. 6*d*. net.

(2) *Feeble-mindedness in Children of School Age.* By Dr. C. P. Lapage. With an appendix on Treatment and Training by Mary Dendy. Pp. xiv+359. (Manchester: University Press, 1911.) Price 5*s*. net.

THESE two books are in a sense complementary of one another, the former being a work which might easily be of interest to the general reader, and will certainly be a useful help to those who are engaged in the care of the feeble-minded, while the latter is essentially a scientific book in which idiocy and imbecility are treated from a more academic point of view. Both works take full advantage of the information obtained by the Royal Commission on the Care and Control of the Feeble-minded, which was appointed in 1904 and concluded its work in 1909.

(1) Dr. Sherlock's book has seventy pages devoted to a brief account of the nature of mind and its physical basis. The two chapters, though brief, give a very good working foundation for the study of mental deficiency. Then follow another sixty-four pages on the nature of the "feeble mind" and its physical basis, including discussions and illustrations of such conditions as microgyria, porencephaly, irregularity of the convolutions, &c. There is also a description of changes in the dura mater, skull cap and scalp and of the various deformities commonly known as the physical stigmata of degeneration.

The chapter on "Causation" is excellent and, *inter alia,* compresses into a short space all the chief views which have been held in modern times as to the nature of heredity.

Dr. Sherlock introduces a new classification of the varieties of idiocy which coincides for the most part with former classifications, but there are some new words which display his known tendency to eschew consonants from his neologisms. The "ateleiotic forms" are the "minds in miniature" without abnormal development of any one faculty, such as occurs in some idiots. The hypertrophic sclerosis of Bourneville receives the new name "epiloia" which includes the author's cases formerly comprised by his term "anoia." All the paralytic cases are grouped together under the name of "plegic forms" and there is a separate group of "residual forms" in which are included presumably all the rarest forms of idiocy. The author does not make any separate group for epileptic idiots inasmuch as he regards the occurrence of fits as accidental to all varieties of idiocy and insufficient to warrant a separate clinical group, however convenient for practical purposes.

The work concludes with a very clear chapter on the handling of the feeble-minded, the way in which they may be placed under care, legal relationships, mental and physical examination, mental and physical training, craftsmasters, craftsmistresses, &c.

(2) Dr. Lapage's book, so far as practical relationship of the feeble-minded is concerned, is based upon experience at the Sandlebridge Colony for the Feeble-minded, and there is an appendix by Miss Mary Dendy, honorary secretary of the Lancashire and Cheshire Society for the Permanent Care of the Feeble-minded, on the treatment and training of these patients.

Her chapter, in common with the rest of the book, is very well arranged under the headings of admissions, food, dress, dormitories, bath-rooms and lavatories, wardrobes, dining- and day-rooms, kitchen utensils, school, work, games, hospital and sick-rooms.

Naturally the treatment of the subject by Dr. Lapage falls under similar headings to those of Dr. Sherlock. There are chapters on the statistics of the subject, on the physical and mental characteristics of the patients, diagnosis and prognosis, &c.

Four chapters are devoted to the condition of the brain in feeble-mindedness and on its causation by inherited and acquired factors.

To the general practitioner an appendix giving a list of institutions for the mentally defective, including asylums, homes, colonies, and schools, will be found exceedingly useful, seeing that mental deficiency is so very common, and the provision for patients suffering therefrom so small and so little known. There is a very good chapter on the defects of speech.

From both the above books we learn that feeble-mindedness is an incurable condition and that the only hope for such patients lies in institution care. The patients can be trained to become useful in handiwork and capable of earning their own living,

but they are incapable of competition in the outside world, and require constant and skilled supervision. There is a large amount of accommodation for these patients, but, as already said, it is too small for the numbers to be found in this country. Those in charge of institutions for the feeble-minded will find a great deal of help in their management and treatment in the book by Dr. Lapage, and they will find considerable interest added to their work if they study these patients in a scientific spirit on the lines laid down by Dr. Sherlock.

ELEMENTARY MATHEMATICS.

(1) *A First Book of Geometry.* By J. V. H. Coates. Pp. xi+142. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* 6*d.*

(2) *A School Algebra.* Part ii. By H. S. Hall. Pp. vi+301–450+xxxix–l. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* 6*d.*

(3) *Theoretical Geometry for Beginners.* By C. H. Allcock. Revised and rearranged. Part i., pp. xii+125. Parts ii.–iv., pp. xii+204. (London: Macmillan and Co., Ltd., 1911.) Price, part i., 1*s.* 6*d.*; parts ii.–iv., 2*s.* 6*d.*

(4) *A New Trigonometry for Schools and Colleges.* By the Rev. J. B. Lock and J. M. Child. Pp. xii+488. (London: Macmillan and Co., Ltd., 1911.) Price 6*s.*

(5) *Solid Geometry.* By C. Godfrey, M.V.O., and A. W. Siddons. Pp. ix+109. (Cambridge University Press, 1911.) Price 1*s.* 6*d.*

(6) *Engineering Descriptive Geometry: a Treatise on Descriptive Geometry as the Basis of Mechanical Drawing, explaining Geometrically the Operations Customary in the Draughting Room.* By Commander F. W. Bartlett and Prof. T. W. Johnson. Pp. vii+159. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1910.)

(7) *Trigonometria Esférica.* By Prof. C. Wargny. Pp. 219. (Valparaiso: Talleres Tipograficos de la Armada, 1909.) Price 6 dollars.

(1) THE object of this small text-book is to give the reader a sound appreciation of the fundamental ideas of geometry, rather than a systematic knowledge of its theorems. Without doubt this is the best way of approaching the subject. As soon as an intelligent grasp is acquired of such concepts as angles, parallelism, areas, &c., it is a simple matter to take a theoretical course; but without this preliminary stage, not only is progress very slow, but the work is in itself of little educational value. Part i., which occupies one-quarter of the book, is entirely practical; part ii. contains a selection of the important theorems of Euclid, I., III., with a large quantity of numerical exercises; it is, in our opinion, unfortunate that few riders have been inserted.

(2) The second part of this book carries the reader up to the binomial theorem. A change from the customary order has been made by taking a first course of progressions immediately after quadratics. As is to be expected of so well known an author, the quality of the workmanship is excellent throughout. The explanations in the text are clear and concise, and the examples have evidently been selected with great care.

(3) In spite of the title of this book, which is a revised form of an older edition, practically no work on experimental geometry has been included. After an introduction of twelve pages on definitions, axioms, postulates, &c., the reader is at once immersed in the theoretical work. The course of theorems given agrees fairly closely with the Cambridge schedule, with a few additions. Each proposition or group of propositions is followed by a number of riders, of which only a few are numerical. We are unable to find any very novel or distinctive features in this text-book.

(4) This volume is designed for the use of candidates for scholarships at the universities, and is intended to form an introduction to the more advanced parts of Dr. Hobson's standard work on the subject. Although it assumes no previous knowledge of trigonometry, the earlier portions are scarcely sufficiently full for the novice in view of the modern idea of taking the subject at a very early stage in the school course. For introductory purposes, some such book as Mercer's "Trigonometry for Beginners" is more useful. But after this preliminary stage is covered, it is well for the student to revise this work once more in such a form as is provided by this text-book. Practical applications are fully treated, and there is an abundance of numerical and graphical work. One important change has been made in the sequence of subjects. The applications to the geometry of the triangle and quadrilateral have been deferred to the closing chapters, thus avoiding any break in the presentation of the purely analytical work. The sections on geometry are far fuller than usual, and indeed contain more than the ordinary boy is likely to require or be able to digest. This is, however, a matter for each individual teacher. We are glad to find a full treatment of the geometrical interpretation of imaginary quantities; the interest which the student takes in this kind of work and the stimulus it applies to his mind more than justify the expenditure of time involved. The general theory of infinite series and products is regarded as beyond the scope of the book, but sufficient is said to justify the validity of the use of those particular series and products met with in the course of the work. Hints for the solution of the more difficult questions are included among the answers.

(5) In spite of recent geometrical reforms, the attention paid to three-dimensional geometry is still, to say the least, inadequate. Time does not allow of a course on the lines of Euclid XI., nor would this be particularly beneficial. What is required is an informal study of the ideas and practical applications of solid geometry; and this is supplied in an excellent and brief form by the work before us. The authors have had a great deal of experience in this direction, and it is not therefore surprising that this small book should seem so admirably adapted to the purpose for which it is intended. It falls into three sections: (1) a discussion of the main properties of lines and planes; (2) the properties and mensuration of the principal solids; (3) the elements of practical solid geometry. The examples are chiefly numerical, but a sufficient

number of riders has been included to test the student's grasp of the theory.

(6) The treatment in this volume is practical rather than mathematical, and is designed for the use of those taking a course in mechanical drawing. Elementary in character, it provides a thorough introductory account of the subject. The first chapter considers in great detail the nature and meaning of orthographic projection, using three planes of reference. Next an account is given of the projection of a straight line and the method of obtaining the true length of a line in space. After this follow successively the treatment of the intersection of planes, curved lines, and surfaces, and the traces of lines and planes with various applications, and the book closes with a description of isometric projection. The excellence of the diagrams is a feature which calls for special remark. The explanations are clearly put, and the work is so arranged that no special mathematical ability is required.

(7) The absence of spherical trigonometry from the ordinary school syllabus is both surprising and unfortunate in view of the practical applications which may be made; nor can this omission be excused on the score of difficulty, since the analysis is scarcely more difficult than that of the corresponding work in plane trigonometry. The explanation, of course, lies in the fact that it is at present excluded from the schedule for university scholarships. The book before us contains in a rather unduly elaborate form the kind of course which might be incorporated in a school programme. After a preliminary discussion on spherical triangles, the methods for solving right-angled triangles are first explained, and then the general case of oblique-angled triangles is considered. Great care is taken to explain the best way of arranging the work in numerical examples. The concluding chapters of the book give applications to geometry, astronomy, and navigation. Theory is throughout subordinated to practice, and those who require a comprehensive working knowledge of the methods of this subject cannot do better than read through this book.

OUR BOOK SHELF.

L'Évolution de l'Électrochimie. By Prof. W. Ostwald. Translated by E. Philippi. Pp. 266. (Nouvelle Collection scientifique: directeur, Émile Borel.) (Paris: Félix Alcan, 1912.) Price 3.50 francs.

THE evolution of electrochemistry affords probably one of the most interesting chapters in the history of the progress of chemical knowledge. Since the birth of this branch of chemistry may be regarded as dating from the discovery of so-called voltaic electricity, the period covered by its history is limited to a little more than a century. The comparative shortness of this period has certain obvious advantages, and the many discoveries of fundamental importance made by investigators in the field of electrochemistry, as well as the development of theoretical knowledge relating to the nature of and connection between electrical and chemical energy afford particularly attractive material for an historical study.

The account presented by Prof. Ostwald, who may be legitimately regarded as the greatest authority on the subject, is admirable in every way, and a more fascinating description of the development of a branch of science cannot well be imagined. The subject-matter and mode of treatment is indicated sufficiently by the titles of the sections into which the text is divided, viz.: (1) introduction; (2) prehistory; (3) Galvani and Volta; (4) Ritter and Davy; (5) from Faraday and Daniell to Hittorf and Kohlrausch; (6) electromotive forces; (7) the beginning of technical electrochemistry; (8) van 't Hoff and Arrhenius; (9) the ionists; (10) modern electrochemical industry; (11) the electron. In this final chapter a very brief but well-written account is given of the results attained in the investigation of the conductivity and the ionisation of gases, which results have given so much impetus to the development of the electron theory.

Much of the material collected and condensed in this little volume is to be found in Ostwald's compendious treatise on "Elektrochemie," published in 1896. This book, largely on account of its size, is comparatively little known amongst students of physical chemistry, and the appearance of a smaller work is therefore in itself an event of some importance.

The Life and Love of the Insect. By J. H. Fabre. Translated by A. T. de Mattos. Pp. x+262. (London: A. and C. Black, 1911.) Price 5s. net.

SEVERAL translators have already drawn from the abundant well of Fabre's entomological studies, and the volume before us is a pleasant addition. We like the grateful tribute to the veteran which the preface pays, and the quotation from Maeterlinck in regard to this "Insects' Homer," "who is one of the most profound and inventive scholars and also one of the purest writers, and, I was going to add, one of the finest poets of the century that is just past."

The book tells us of the sacred scarabee supremely inspired by the instinct of maternity to wonderful industry and not less wonderful art; of the Spanish Copris which kneads a large loaf and divides it into pills, one for each egg; of the common dung-beetles (Geotrupes), who belong to the public health service, and are often deservedly decorated; of *Minotaurus typhaeus*, a black beetle of the sheep's pasturage, who burrows and bakes, and even makes sausages; of the ringed Calicurgus, which first stings its captured spider in the mouth, paralysing the poison fangs, and then, safe from being bitten, drives in its poisoned needle with perfect precision at the thinnest part of the spider's cuticle between the fourth pair of legs; of the leaf-rolling Rhynchites, which spends the whole day in making an inch-long cigar with eggs between the layers of the scroll; and of the mother of the Halictus bee family, who becomes in her old age the portress of the establishment, shutting the door with her bald head when strangers arrive, opening it by drawing aside when any member of the household appears on the scene. And so the stories run, full of dramatic situations and romantic interest. We know not which to admire the more, Fabre's style or his eyes. The translator has given us a fine rendering, which reads like the original.

(1) *Aids to Bacteriology.* By C. G. Moor and Wm. Partridge. Second edition. Pp. viii+240. (London: Baillière, Tindall, and Cox, 1911.) Price 3s. 6d. net. Paper, 3s.

(2) *Aids to Pathology.* By Dr. H. Campbell. Second edition. Pp. viii+228. (London: Baillière, Tindall, and Cox, 1911.) Price 3s. 6d. net.

THESE two little books contain a large amount of information in a small space. Neither professes to be more than an outline of the subject of which it treats, but both seem to be successful in their aim—that of acting as epitomes for the student and practitioner.

(1) The bacteriology treats of bacteriological methods, pathogenic bacteriology, and bacteriology as applied in hygiene in the examination of water, milk, foods, disinfectants, &c. A few slips need correcting—*e.g.* the statement that an antibody consists of two parts (p. 19)—and the Wassermann reaction needs amplifying somewhat; otherwise there is little to criticise, and some portions of the book are particularly good, *e.g.* the section on disinfectants.

(2) The pathology suffers somewhat from the attempt to include everything in so small a book—*e.g.* diseases of the teeth and parasitic worms—and other more important and fundamental processes are in consequence too briefly discussed. Fatty infiltration and degeneration are treated as though they are quite distinct. It is stated that active immunity is conferred by the injection of an anti-serum, whereas it is correctly stated a couple of lines later that this procedure confers a passive immunity. The diagrams indicating the interaction that occurs in the Wassermann reaction should render this subject clear.

R. T. H.

Senior Chemistry. By Dr. G. H. Bailey and H. W. Bausor. Pp. viii+509. Price 4*s.* 6*d.*
Senior Magnetism and Electricity. By Drs. R. H. Jude and J. Satterly. Pp. viii+446. Price 5*s.*
Senior Heat. By Drs. R. W. Stewart and J. Satterly. Pp. viii+300. Price 3*s.*
(London: W. B. Clive, University Tutorial Press, Ltd., 1911.)

ALL these books are based upon previous volumes issued by the same publishers. The first is an adaptation apparently of Dr. Bailey's "Chemistry for Matriculation," which was reviewed in our issue of May 11, 1911 (vol. lxxxvi., p. 345); the second of Dr. Jude's "Matriculation Magnetism and Electricity," noticed in these columns on June 23, 1910 (vol. lxxxiii., p. 485), and the third of the late Dr. Stewart's book on heat, noticed at the same time as the volume on magnetism and electricity referred to.

It would seem that the present volumes cover those parts of the respective subjects included in the syllabuses for candidates presenting themselves at the Senior Local Examinations conducted by the University of Cambridge.

Fifty Useful Metric Equivalent Tables. (London: The Central Translations Institute, n.d.) Price 6*d.* net.

PROVISION is made in these tables for the range of equivalents likely to arise in commercial dealings between this country and others using the metric system. The calculations are based upon figures supplied by the Board of Trade. The price equivalents deal with feet, yards, square feet, square yards, cubic feet, gallons, pounds avoirdupois, hundredweights, and forty cubic feet measurements—which are useful for checking freight charges. The prices are calculated at the rate of exchange of 25.22 francs to the £.

A Handbook of Physics and Chemistry. By H. E. Corbin and A. M. Stewart. Pp. viii+519. Fourth edition. (London: J. and A. Churchill, 1911.) Price 7*s.* 6*d.* net.

THE first edition of this book was reviewed in NATURE of January 4, 1900 (vol. lxi., p. 221). It will suffice to say that in its present form the volume covers the extended syllabus of work required for the first examination of the Conjoint Examining Board of the Royal Colleges of Physicians and Surgeons. Additional articles have been introduced in the present edition on hydrostatics, the polarisation of light, and Röntgen rays.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Electricity and Vegetation.

WITHOUT pretending to answer the question raised by Mr. Benham at the conclusion of his letter on p. 41 of NATURE of November 9, and without prejudging the results of recent experience on electrification of crops as reported on by Dr. Priestley and other impartial investigators, I would remind him and your readers generally that it is unsafe to attach a positive conclusion to a negative result obtained by supposed electrification of a wire network over a field, unless there is reasonable guarantee that such network was really kept positively electrified during considerable periods.

For instance, it has been attempted in the past, and it is still tempting, to supply electricity to a network by means of elevated spikes, arranged so as to utilise the gradient of potential naturally existing in the atmosphere. But think what singularly perfect insulation would be required to enable electricity slowly supplied in this way to accumulate until a fizzing point was reached. The attainment of such potential over a large area would in this climate be quite impracticable except when a thundercloud was passing overhead.

The same difficulty of adequate insulation must have militated against many attempts made in the past to supply electricity from artificial but old-fashioned high-potential sources, especially when the area to be supplied extended over many acres.

It must be further remembered that any metallic network not really charged, but kept practically at zero potential by leakage to earth, would be presumably detrimental to the growth of plants beneath it; inasmuch as it would tend to screen them from the natural inductive electrification to which they are entitled.

OLIVER LODGE.

Fish and Drought.

THE summer of the year 1911 will long be remembered for its excessive heat and dryness. These were especially trying to the inhabitants of streams and shallow lakes or ponds. I had the opportunity of studying a remarkable instance of this, which I think is worth recording.

The Château of Marchais, with its magnificent domain, the property of the Prince of Monaco, lies about 16 kilometres east of Laon, in the department of Aisne, and is well known as one of the best shooting estates in France. The sketch (Fig. 1) represents the park. It occupies a rectangle surrounded by a ditch or moat, A, B, C, D, consisting of four canals, each 1250 metres long and 16 metres wide, and carrying usually a depth of 1½ metres of water. These canals form a continuous sheet of water, 5 kilometres long, and there is a bridge, *a*, *b*, *c*, *d*, over each of them. The country, though well-wooded, is flat and peaty, and the level of the water in the ditch is that of the water in the ground all round it. Like the ground-water, it is subject to rise and fall according to the wetness or dryness of the season.

When I arrived on the morning of September 29, I observed that the ditch was quite dry, with the exception of the small tank or enclosure (*f*) for ducks at the lodge known as the Porte Rouge, where entry to the park is obtained over the bridge marked (*b*). Yet the water of the ditch is always full of fish, principally carp, tench, perch, and pike. Now there was nothing but dry mud. *With the water the fish had entirely disappeared, and without leaving a single dead one to mark where they had before abounded.*

On the evening of September 29 a violent storm of wind and rain broke, and it raged over the whole of northern Europe until October 1. I was curious to see the effect which this first important rain, which marked the breaking of the drought, would have on the ditch.

It is right to say that the full significance of the dryness of the ditch and the absence of dead fish had not sufficiently impressed me. I only felt that I was witnessing a

remarkable occurrence in nature and it excited my curiosity, but at first this curiosity went very little beyond considering how long it would take for the water to get back. With only this in my mind, I went round the park on the afternoon of September 30, when the weather had moderated a little, and I found that pools of water had begun to collect in places in the ditch, but I did not examine them, and I arrived at the conclusion that a little steady wet weather would soon fill the ditch up again.

On October 1 the weather was still very bad, but between the showers I took a walk along the margin of the ornamental water (*h*) on the west side of the château (*k*), which is connected with the south canal of the moat. A pool of water had collected here, and there was quite a quantity of small fish, not more than 10 or 12 centimetres in length, swimming about in the water, which did little more than cover its muddy bottom to a depth of at the most 4 or 5 centimetres, in which these small fish were able to swim. I noticed that the water was turbid and that the mud was

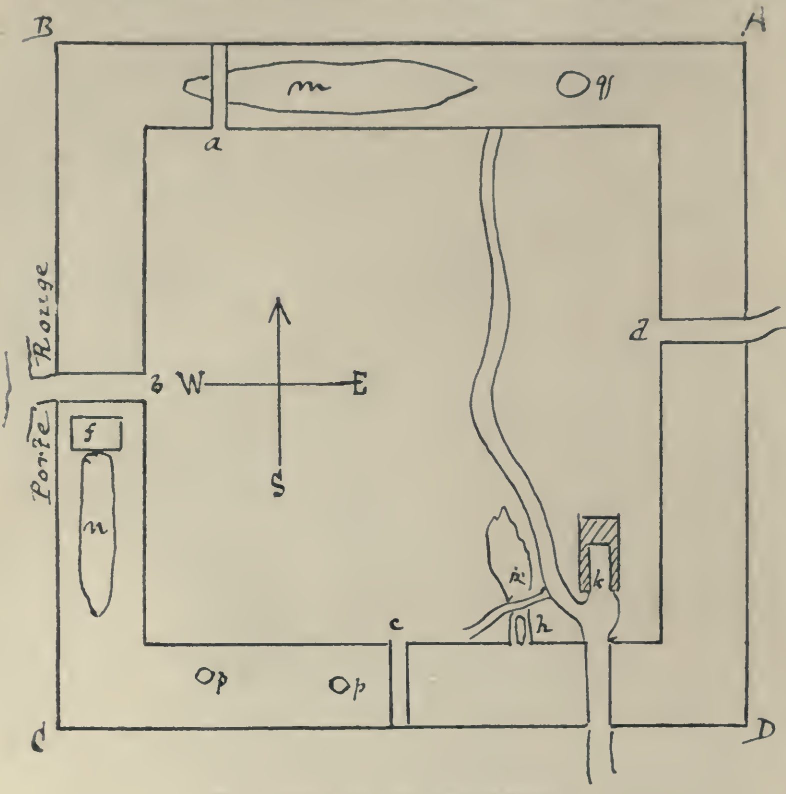


FIG. 1.—Sketch Plan of the Park of Marchais.

everywhere being stirred up by the fish. They were darting hither and thither, being disturbed by my presence on the bank, and, whenever they altered their course, they contrived to raise a dense cloud of mud, in which they were able for a short time to conceal themselves from view.

Two days before these fish were invisible, and now they had reappeared in an isolated shallow pool, which also had no existence two days before. *It was evident that all these fish had been covered by the dry mud, and must have released themselves the moment they thought there was enough water for them to swim in.* There was not by any means too much water for the crowd that was moving about in it. I was fascinated by what I saw, especially as it seemed to be in every way likely that the process of release was still going on. But the release of a buried fish would be sure to be accompanied by a cloud of mud, which could not be easily distinguished from that produced by a fish already in freedom and swimming about. Still, considering the shallowness of the water and the very favourable position for following everything that went on in it which I occupied on the bank, I was convinced that there would be some noticeable difference between the two classes of cloud, and I was not mistaken. After waiting and watching for some time, I saw a mud-cloud rise in the very shallow water, bringing a fish with it to the surface belly upwards. It lost no time in righting itself and swimming away with the others. A living fish can adopt this attitude only when it has not got full control over its movements, and this is pretty sure to be the case at the moment when it releases itself from burial. By waiting a little longer I witnessed two or three repetitions of this remarkable act.

In a pool such as that which I had under observation, in which the water was not more than two or three centimetres deep, the liberated fish reaches the surface almost as soon as it quits the bottom. In any case it is highly probable that the fish would arrive at the surface before it had fully seized the situation, and the nervous impulse had arrived at the muscles and started them in their righting and locomotive activity.

In water a very little deeper it is probable that the fish would be able to right itself before floating clear of the cloud of mud produced by its struggles in the act of self-exhumation.

In the afternoon I went round the park, and found an extensive pool of water which had collected in the north canal and occupied its western half. There were great shoals of fish, principally perch, darting about, and, in their alarm at being surprised in unusually shallow water, stirring up clouds of mud everywhere. Amongst them was one large pike, quite 40 centimetres in length. The water shoaled off to nothing at both ends of the pool, and in the middle it was perhaps 30 centimetres deep. The pool was far too long to be watched like the smaller one, and I was not able to observe any individual release from the mud. However, I noticed that, with the exception of the large pike, the fish were all small; I estimated them to be not more than 10 to 12 centimetres long.

From the western end of this pool round the north-west corner and along the western canal to the bridge (*b*), at the Porte Rouge, the canal was quite dry. At the Porte Rouge there was the small enclosed tank for ducks (*f*), and beyond it the canal was again dry. The bottom of this canal does not consist of the fine mud which is found in the north canal; it is hard, sandy, and marly, and there was no sign of life in it anywhere. The same class of bottom with absence of life prevailed in the south canal.

On October 2 the weather had improved, although it was very cold, and I studied the canals both in the morning and the afternoon. In the large pool in the north canal I found the quantity of fish augmented, and I especially noticed that there were many more large fish present than before, and the average size of the fish was decidedly greater than on the previous day; perch of at least 20 centimetres in length were present. The bigger fish had probably started to bury themselves earlier than the smaller ones, and had buried themselves deeper. I saw the big pike of the day before, and two others of the same species, but very much smaller, had appeared. *One dead perch was floating in the pool, the first dead fish that I had encountered.* In the afternoon it seemed to me that the average size of the fish in the pool was still on the increase. The west and north canals presented the same appearance as before.

On October 3 the weather kept fair but cold. I went round the park and found the big pool in the north canal much the same as on October 2, the number of large perch having apparently increased, but there was no new feature of importance. In the course of my tour, after passing the Porte Rouge, I found that the part of the west canal south of this lodge had begun to collect water, which already covered the bottom, forming a pool (*m*), extending to within a short distance of the south-west corner. Under the

water, which was perfectly clear, the light grey bottom was still cracked and apparently unsoftened, and there was not a trace of life of any kind. In the south canal the bottom was generally dry, with, however, every here and there pools of water measuring about one metre across, and in these also there was no trace of life. I learned that anglers never fish in these canals, because they know that they will catch nothing.

In the afternoon I revisited the north canal, and instead of following the big pool westwards, which promised nothing new, I turned to the right and followed it eastwards towards the north-east corner. I had not gone very far before I encountered a phenomenon of which I had already perceived the possibility, namely, *a premature resurrection resulting in widespread death.* This part of the canal was apparently dry, in the sense that the bottom was exposed to the air, but nevertheless moist enough to be called wet. Owing, probably, to a slight general rise of the ground-water of the neighbourhood, enough water had been able to filter through the mud of the bottom and to rise to the surface and overflow, producing a very shallow pool (*q*), not more than 2 or 3 centimetres deep or more than a metre across. The wetting of the mud below by this infiltration must have aroused the sleepers, who then all started to rise at the same time. But when they released themselves from the mud there was not enough water to float them all, and a formidable struggle for existence was going on at the time of my visit, and the quantity of dead and dying fish lying all round the edges of the pool furnished sufficient evidence of its fierceness. The poor fish would no doubt have willingly re-buried themselves and so saved their lives when they perceived their mistake, but the stronger ones, which were in possession of the only part of the pool which could be called liquid, kept shouldering them outwards on to the mud, where they died in the air. When I left the struggle was still going on, and it looked as if the level of the water was falling, so that it is unlikely that many, if any, would be able to retrieve their mistake by burying themselves again. As I left for England the next morning I was not able to continue my observations.

Although the years vary much as regards humidity, and in dry summers the supply of water in the ditch has often fallen to a pretty low ebb, I was informed that the last time that the ditch became quite dry was in the year 1814, almost a hundred years ago; therefore *the experience of the summer of* 1911 *must have been a new one for all the fish in the ditch, yet the general manœuvre of protective burial was carried out without a casualty.* In order to accomplish this a fine instinct was necessary to perceive the impending drying up of the canal, and then commence the operation betimes so as to finish it before desiccation was complete.

It must be remembered that the area of canal having the muddy bottom, which alone is capable of receiving them, is very restricted; and from the number of fish that came out of it in the short time that I was observing they must have been packed very closely, and in such an orderly way that, with the return of water in sufficient quantity, they were able to take to it again apparently without having suffered at all.

Although the instinct of the fish seems to have sufficed to make them foresee and provide for the dryness, it does not seem in all cases to have been sufficient to enable them to judge correctly the right moment for beginning their release.

Of the different species which inhabit the waters of the ditch, the carp and the tench have the habit of burying themselves in the mud every winter; but the perch and the pike have not this habit; both can be caught at any time in winter, even under a covering of ice; yet both the pike and the perch must have buried themselves with quite as much skill as the carp or the tench.

But in a climate like that of this part of France shallow lakes and ponds may suffer shortage of water by congelation as well as by evaporation; and the Prince informed me that he remembered one winter when in many places the water of the ditch was frozen almost, if not quite, to the bottom, and quantities of pike and perch were frozen into the ice. This form of desiccation did not prompt them to seek refuge in the mud.

It is evident that if the summer of 1911 had marked the beginning of a secular period of dryness, such that the canals were not again to be flooded, the fish which took to the mud in that summer would be kept there. They would die and decay *in situ*, and would be perfectly preserved in well-arranged though crowded masses. Eventually, if the change of climate was final, they would form a rich and interesting bed of fossil fishes. But the interest would depend not only on the abundance of fossils in the muddy matrix of one part of the trough-like formation; it would be intensified by their complete absence in the hardened marly matrix of the other part.

Before serious drying took place the ditch, or trough, was covered by a continuous sheet of water in which the fish and other creatures could circulate freely to all parts. So soon, however, as actual desiccation appeared to be imminent, the fish must have concentrated themselves in a body over the districts of muddy bottom in which they knew they could take refuge as a last resort. *When desiccation was complete every fish in the ditch, without a single exception, had succeeded in burying itself in one or other of these restricted areas of mud. Not one of them appears to have made the mistake of seeking refuge in the marly bottom.* When completely dry the ditch, or trough, consisted of two formations, the more extensive consisting of hard sandy marl and destitute of life, the less extensive consisting of soft mud and teeming with aquatic life. Further, the two formations are contiguous as well as contemporaneous, and together they cover an area of not more than eight hectares.

As illustrating the geological significance of the facts just recorded, the following passage may be quoted from Sir Archibald Geikie's "Text-book of Geology" (1903), p. 1003:—

"The water basins of the Old Red Sandstone might be supposed to have been, on the whole, singularly devoid of aquatic life, inasmuch as so large a proportion of the red sandy and marly strata is unfossiliferous. In some of the basins, where the sediment is not red and sandy, it is evident that life was extremely abundant, as is shown, for example, by the vast quantities of fossil fishes entombed in the grey bituminous flagstones of Caithness and Orkney. It may be observed that where grey shales occur intercalated among red sandstones and conglomerates they are often full of plant remains, and may contain also ichthyolites and other fossils which are usually absent from the coarser red sediments. There would appear to have been occasions of sudden and widespread destruction of fish life in the waters of the Old Red Sandstone, for platforms occur in which the remains are thickly crowded together, yet so entire that they could not have been transported from a distance, and must have been covered over with silt before they had time to decay and undergo much separation of their plates."

The last sentence of this passage seems to describe the actual condition of the muddy bed of the moat round the Park of Marchais as it would appear to a geologist after the necessary interval of time had elapsed which is required to separate the date of the death of the crowd of fishes which voluntarily entombed itself in the mud before desiccation was complete, and the date at which the stratum of mud and remains so produced would be entitled to rank as a geological formation. I do not know if there are any adequate data for arriving at a trustworthy estimation of the probable length of this interval. It is quite distinct from what is understood as the age of the geological formation.

The barren districts of sandy and marly matter at the bottom of the ditch would, after the lapse of the same, or perhaps a shorter, interval furnish perfectly unfossiliferous strata, which would suggest to the geologist of later date that the water basin in which it had been laid down had been singularly devoid of aquatic life. Yet, in a sense, it would not be inaccurate to say that the water basin in which the muddy strata holding the crowded fish remains had been "laid down" teemed with life, and that the barren strata had, in the same sense, been "laid down" in water devoid of aquatic life, although the two bodies of water formed one continuous sheet of very restricted dimensions. *It would seem, therefore, that a material barrier is not necessary to separate even a small body of*

water into two basins and to maintain them distinct, the one of which may be full of life and the other practically barren.

There is an important point, which should not be missed, in the similarity between what took place this summer at Marchais and what may have taken place in Caithness or Orkney in the Old Red Sandstone period. The fishes which buried themselves in such numbers in the mud this summer, though they were fortunately released, were in the strictest sense contemporaries, and were all buried in the mud within a few days of each other. Moreover, in ordinary circumstances, at least in summer, the mud is untenanted. If the fish were to migrate into the barren waters covering the marly bottom, and their return were barred while the water over the mud evaporated and the secular drought set in, this same mud-bed would be met with in later ages as an unfossiliferous stratum. *So that the fossil fishes which are found in these strata must be held to have gone into occupation only when the signal, intelligible to them, was made that complete desiccation was going to take place. Once in a way this desiccation turns out to be secular, and we have a rich bed of fossils.*

In conclusion, I think that the behaviour of the fish in the ditch at Marchais in the summer of 1911 adds one more fact to the body of evidence which goes to show that, *in the production of geological formations, transportation of material has probably been the exception rather than the rule.*

J. Y. BUCHANAN.

The Inheritance of Mental Characters.

I HAVE just read Dr. Archdall Reid's paper "Methods of Research," communicated to the Eugenics Education Society. Situated as I am in Scotland, it was impossible for me to attend the discussion which I understand took place recently, and I had no opportunity of reading his paper until he sent it to me. He makes certain statements with regard to a very controversial point, the inheritance of mental characters; and, having had no chance of criticising these, I should be much obliged if you would give me the opportunity of doing so.

Prof. Pearson, as quoted by Dr. Reid, says:—"We inherit our parents' tempers, our parents' consciousness, shyness, and ability, even as we inherit their stature, fore-arm, and span." This statement may be loosely expressed and open to misinterpretation; but no one has a right to assume, without further explanation, that more is meant than the inheritance of capacity or absence of capacity for making particular acquirements, whether Prof. Pearson actually had this idea in his mind when he wrote or not. At any rate, by ability he undoubtedly means capacity for making acquirements.

Dr. Reid says:—"Pearson's statement is utterly without significance, utterly devoid of all content. Founded with such an air of scientific accuracy on statistics and family histories which have such an appearance of scientific precision, it is so vague as to be quite nonsensical." This statement certainly does not err on the side of vagueness. If it is as true as it is definite it reduces the mental capacity of all men to that dead-level of competence or incompetence which is the apparent ideal of Socialists and trade unions; it necessitates the adoption of some other explanation than the action by selection upon the inborn variations for the evolution of man's capacity for making mental acquirements; and it leaves the undoubted existence of variations in mental capacity, including feeble-mindedness, unaccounted for.

Unless Dr. Reid believes that the intellectual development of man has been brought about by the action of some supernatural power or by the inheritance of acquired characters, he must believe that it has been due to the action of natural selection upon inborn variations. The term "mental character" is used by both Dr. Reid and Prof. Pearson in such a way that both inborn and acquired characters are included. The former classes the speaking of English, the latter temper, shyness, and ability, as mental characters. Many, perhaps most, of our mental characters, using the words in this loose sense, are acquirements; but these acquirements depend upon an inborn capacity for making them, and this capacity, like all inborn characters, is subject to variations. Without this it is difficult to see how man's capacity for making mental acquirements could ever have been evolved. Apply the method, which Dr. Reid supports so strongly and explains so clearly, to his own examples and those of Prof. Pearson! All normal English children speak English. All normal French children speak French. The particular language spoken is an acquirement, dependent upon the environment. But it is impossible for Dr. Reid to maintain that, given precisely the same opportunities, all individuals are likely to attain the same degree of skill in the use of the language they have acquired. Moreover, they will vary in the facility with which they acquire skill in the different ways of using the language. Some may readily acquire an abundant flow of words in speaking, others may more easily attain a facile and clear style in writing. Does Dr. Reid believe that a great English orator or writer would not, *ceteris paribus*, have been a great orator or writer simply because his medium happened to be French instead of English? This variability in the capacity for making acquirements must apply to all acquirements. An individual may be able to acquire a high degree of development in music under comparatively unfavourable conditions, but be quite incapable of rising, even to the average, in mathematics under favourable conditions, and *vice versa*. Unless the existence of these variations in mental capacity and the possibility of their transmission from parents to offspring are admitted, it is impossible to account for the evolution of the human intellect by the action of natural selection upon inborn variations.

Now take Prof. Pearson's first example, as quoted by Dr. Reid—temper! I do not think that anyone will quarrel with the postulate that this word is used to express the control, or lack of control, over the emotions exhibited by an individual, the strength of the emotion being a variable quantity according to the susceptibility of the individual to the stimulus producing the emotion. This susceptibility will vary just as grocers' scales vary from a delicate chemical balance, though both respond in a similar manner to the same kind of stimulus. "Good-tempered" implies the possession of a high degree of control or a low degree of susceptibility, or a combination of both. "Bad-tempered" means a lack of control or a great susceptibility, or a combination of both. Dr. Reid might contend that the example of a bad-tempered parent might produce a bad temper in the child. On the other hand, it is at least equally probable that the exhibition of bad temper on the part of a child to a bad-tempered parent would bring swifter and greater punishment than would have been the case had the parent been good-tempered; and thus the bad temper in the child would be more than usually checked. In the absence of direct evidence of a comprehensive and conclusive nature we must assume, given identical environment, that the susceptibility to stimuli tending to produce manifestations of temper is different in different individuals, and is an inborn character; that the capacity for acquiring control over the emotions varies in different individuals, and is an inborn character; and that these variations are transmitted in an increased or lessened degree to their offspring by the parents. These inborn characters are, of course, susceptible to great modification by the environment.

Using, I believe, methods approved by Dr. Reid, I have thus come to the same conclusion that Prof. Pearson has arrived at by a different road, and hold that mental characters are transmitted from parents to offspring, though I fully realise the great extent to which these inborn characters may subsequently be masked by superimposed acquirements. If this conclusion be correct, then the consideration of the inborn mental characters of the parents is even more important, from the eugenic point of view, than that of the inborn physical characters, and far more serious than any question relating to education.

What has surprised me is that on all previous occasions Dr. Reid's opinions seem to have been in complete accord with the arguments put forward here. Hence I do not understand his unqualified condemnation of a statement which does not appear, on the face of it, to be at variance with his own views.

CHARLES WALKER.

Glasgow, October 12.

Nature of Light Emitted by Fireflies.

THE nature of the light emitted by fireflies (Malacoder-nidæ fam., genus Luciola) has hitherto been very little nvestigated. The idea that it is phosphorescent seems to ave been generally accepted. On observing the beautiful reen fluorescence of the light emitted by the insect when t is put in a glass tube, we were struck by the close esemblance of this light to that of the Crookes's tube. Could it be like that of the X-rays?

An inquiry was instituted to see how it affects photo-graphic plates through different media. Various media vere tried, and the results obtained by interposing wood, lark brown leather, flesh, and black paper are described elow. It may be remarked here that the light emitted by he insect is so fitful and faint that it is rather difficult to keep it steady, and it will be too much to expect this faint ight to give more than shades of varying depth on the plates. It was observed that the capacity of the insect to affect the photographic plate depends on the length of the exposure. When the insect was put on a naked plate for a few seconds, it did not affect the plate, but when it was similarly held on the plate for one minute, its effect was distinctly visible. After a series of experiments, therefore, two hours' exposure in the case of paper and flesh, and three hours' exposure in the case of leather and wood, were considered sufficient.

(1) An extra rapid photographic plate was placed in a dark slide, and three insects were then placed on the slide beneath a watch glass; the whole plate was affected and gave dark grey print after an exposure of three hours. Without the insect, the plate gave a black print on a two minutes' exposure to lamp-light.

(2) An extra rapid photographic plate was enclosed in English tanned leather of a dark brown colour 1 mm. thick. The three insects were placed on the leather, with the result that the plate gave a dark grey print after three hours' exposure; a similar plate, similarly enclosed, when exposed to lamp-light for two minutes gave a black print

(3) The three insects were placed in a small tube open at one end, which was enclosed in a piece of flesh (mutton) 1·5 mm. thick; this was placed on a naked plate in a dark room. Where the light was not intercepted by the glass of the tube, the plate showed a white print after an exposure of two hours. A similar plate was covered with a piece of flesh of similar thickness and exposed to lamp-light; the resulting print was dark grey after two minutes' exposure.

(4) A similar plate was enclosed in black paper and the insects placed on it beneath a watch glass; the resulting print was, after two hours' exposure, light grey; while a plate similarly covered exposed to lamp-light for two minutes was very slightly affected, and gave a very dark grey print. The plate exposed to lamp-light without any media for two minutes gave a light grey print.

It was seen that the insect light approaches lamp-light in the intensity of its effect on the photographic plate, even when the different media opaque to light are interposed between the two.

The light emitted by the insect cannot therefore be taken as phosphorescent. It may be, perhaps, premature to conclude that some of the rays emitted by the insect are X-rays, but it may be safely asserted that these rays are, at least, similar to X-rays and ultra-violet light in so far as they render certain opaque media transparent and are intercepted by glass. We hope this short note may be the precursor of elaborate experiments on the subject leading to some definite results.

PURAN SINGH.
S. MAULIK.

Dehra Dun, November 2.

Trematode Generic Names Proposed for the "Official List of Zoological Names."

(1) THE International Commission on Medical Zoology, appointed by the Graz International Zoological Congress, has made its first report on the names of Trematode genera parasitic in man.

(2) Four members, namely, Blanchard (Paris), Monticelli (Naples), Stiles (Washington), and Zschokke (Basel), unanimously agree that the following eleven names are, from the present point of view of systematic zoology and nomenclature, the correct names for the genera in question, and that the species cited as genotypes are the correct types according to the International Rules of Zoological Nomenclature:—

Clonorchis Looss, 1907, February 1, 147–152, type *sinensis*.

Dicrocoelium Dujardin, 1845a, 391, type *lanceatum* = *lanceolatum* (= ? *dendriticum* sub judice).

Fasciola Linnæus, 1758a, 644, 648–649, type *hepatica*.

Fasciolopsis Looss, 1899b, 557, 561, type *buskii* (seu *buski* teste Blanchard).

Gastrodiscus Leuckart in Cobbold, 1877e, 233–239, type *sonsinoii* (seu *sonsinoi* teste Blanchard).

Heterophyes Cobbold, 1866a, 6, type *aegyptiaca* = *heterophyes*.

Metorchis Looss, 1899b, 564–566, type *albidus*.

Opisthorchis Blanchard, 1895f, 217, type *felineus*.

Paragonimus Braun, 1899g, 492, type *westermanii* (seu *westermanni* teste Blanchard).

Pseudamphistomum Luehe, 1908, 428–436, type *truncatum*.

Watsonius Stiles and Goldberger, 1910, 212, type *watsoni*.

(3) The following commissioners have not voted:— Jaegerskioeld (Gothenburg), Looss (Cairo), Luehe (Koenigsberg), Pintner (Vienna), and Shipley (Cambridge).

(4) Notice is hereby given that the undersigned will wait until July 1, 1912, for any zoologist to raise any objection to any portion of this report, and that on that date all names to which valid objection is not raised will be forwarded to the International Commission on Zoological Nomenclature with the motion that these names be included in the "Official List of Zoological Names" provided for by the Graz Zoological Congress.

(5) All correspondence on this subject should be addressed to the undersigned.

C. W. STILES.
(Secretary International Commission on Zoological Nomenclature.)

Hygienic Laboratory, Washington, D.C., November 11.

Dews in 1911.

IT may interest readers of NATURE to know that between July 31 and September 5 this year I collected a total amount of dew equivalent to one-fifth of an inch of water, whilst in 1909, between August 3 and September 12, about one-tenth of an inch was collected. That is to say that this year the dews were twice as heavy as in 1909, or we may state that during the above-mentioned period of this year the deposit of dew in my instrument was equivalent to 20 tons of water per acre. Of course, most of this was evaporated, but that amount of water could have been collected with adequate means.

This year has been disastrous to the so-called dew-ponds, and I would remind readers of the view expressed in a letter to NATURE of May 14, 1908, that the ponds are "simply water butts in which rain-water is stored." A pond on the summit of St. Boniface Down, Ventnor, which I visited on September 1 this year, was absolutely dry.

I have been led to write this note because Mr. Martin, in his interesting letter in last week's NATURE, p. 77, says that "this year the absence of rain for so long brought about a remarkable absence of dew." This was not my experience, except on two or three clear nights when the air seemed to be very dry.

The details of my measurements and of my instrument I hope to publish elsewhere.

SIDNEY SKINNER.

South-Western Polytechnic Institute, Chelsea, S.W., November 18.

The Colours of Fishes.

INTEREST as to the sources of colours in birds and insects has been revived by Prof. Michelson in *The Philosophical Magazine* for April, and by Mr. Mallock at the Royal Society. The inquiry will be assisted if fishes may also be included. Nature reveals no more vivid form of shifting tints than we see in the common mackerel, which is a fish without scales. In August I was able to watch them immediately after the fish had been taken from the sea I

was surprised to find the skin so firm and tough; I almost expected to spoil it in handling; the delicate colours seem as if they might be tender like the bloom of a grape. With the smooth, but not sharp, edge of a knife I scraped the surface somewhat vigorously without damaging the lovely play of blue and green light.

Two or three weeks elapsed before I could examine dried pieces of the skin with a microscope. There did not appear to be any orderly markings which could lead to diffraction; nor could I find a flaking tendency which would suggest thin plates. The glancing of the colours from blue to green is lively, but I should think it is not due to wave interference. Pigments can be greatly modified by a change in the angle of incident light, according to the qualities of lustre surfaces as described by Helmholtz, and the polarisation principles worked out by Jamin. These two considerations form the basis of an important portion of the comprehensive discussion given by Michelson. W. B. CROFT.

Winchester College, November 13.

The Weather of 1911.

WITH reference to Sir Edward Fry's letter in NATURE of November 16 in regard to the weather of 1911, without presuming to reply on behalf of meteorologists to his question as to whether any real cause can be assigned for the brilliance and heat of its summer and autumn, may I be allowed to suggest that the relatively high temperature of the North Atlantic, during the period, presumably conduced to warmth and sunshine? Since April the surface temperature of the North Atlantic has been, for the most part, above the average, and during the months of June to September, inclusive, largely above. Not only through the agency of winds from seaward has air temperature over our islands been raised by the abnormal warmth of the ocean, but also, it seems probable, through the diminution of cloudiness, and the corresponding increase of sunshine attributable to the small difference, thus ensuing between the temperature of the sea and that of the air above it.

Moreover, during a bright summer, the heat which the earth receives through solar radiation may be greatly in excess of that which it parts with at night by terrestrial radiation. CAMPBELL HEPWORTH.

2 Amherst Road, Ealing, W., November 18.

ROTATION PERIOD OF THE SUN.[1]

SINCE the introduction of the Doppler-Fizeau principle one of its most interesting and important applications has been to the determination of the velocity of the sun's rotation by the investigation of shifts of the spectrum lines corresponding to various points on the solar limb. Much of the pioneer work in this direction was done by Vogel, Young, Langley, Cornu, and Dunér, the results obtained by the latter at Upsala from 1888 to 1903 serving as the standard for future workers. Dunér's determinations referred to points between the solar equator and 75° north and south heliographic latitude, the observations being made at intervals of 15°. During 1903–6 Halm made a series of observations at Edinburgh, employing the same differential method as Dunér.

All these observations having been made by visual methods, it was considered of importance that the photographic method should be tried, and this was commenced on the completion of the Snow telescope on Mount Wilson in the spring of 1906. In June, 1907, the tower telescope, with vertical spectrograph of 30 feet focal length, was completed, and thenceforward the observations for rotation were made with it, the spectra being of such greatly increased resolving power that the investigation was considerably facilitated.

[1] "An Investigation of the Rotation Period of the Sun by Spectroscopic Methods." By W. S. Adams and J. S. Lasby. Washington D.C., Papers of the Mount Wilson Solar Observatory. Vol. i., part i. (The Carnegie Institution, 1911.)

Five series of observations have been made—tw dealing with lines selected from the spectrum of th general reversing layer, two with the Hα line o hydrogen, and the fifth with the blue line of calciu at λ 4227. As the lines of hydrogen and calcium giv results differing widely from those obtained for th reversing layer, the various sections are treat separately in the discussion.

The 1906–7 series of observations were made in co junction with the Snow telescope, having a spectru scale of 1 mm. = 0·71A, on a list of lines selected being representative of the different strata involv Those made in 1908, with the tower telescope an spectrograph of 30-feet focal length, are with a spe trum scale of 1 mm. = 0·56A. For the reversing lay photographs twenty-two standard solar lines wer selected for observation, representing the elements La Cr, Zr, Fe, Mn, Ni, Ti, and the compound CN.

In the general discussion it is shown that the tw series of observations are in substantial agreemen for latitudes between 0° and 50°. Above 50° th

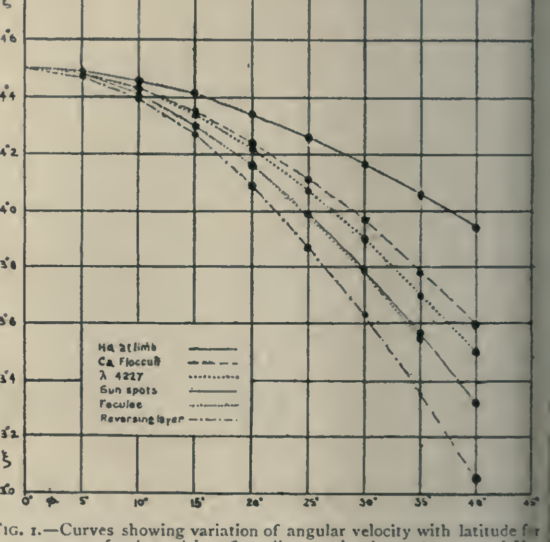


FIG. 1.—Curves showing variation of angular velocity with latitude for sun-spots, faculæ, calcium flocculi, reversing layer, λ 4227, and Hα. To facilitate comparison the curves are all reduced to the common origin of 14·50°. Differences in the amount of equatorial acceleration are indicated by lack of parallelism in the curves.

1908 observations give slightly smaller values, th greatest difference being about 0·039 km. at 70°. I is surmised that these small differences may be partl due to small systematic errors in the earlier series and partly to actual proper motions in the vapour constituting the sun's reversing layer.

The general results do not indicate any definit variation of the sun's rate of rotation, except it be c long period. This conclusion is emphasised by th close agreement of the Mount Wilson results wit those given by Dunér.

One of the most notable results brought out clearl by these observations is the fact that the lines c different elements give different values of the rotatio velocity. Thus lines of lanthanum and cyanogen giv low velocities, while certain lines of manganese an iron give comparatively high velocities. A table i given showing the residuals on forming the difference in the values of the angular velocity for each line fror that of the mean of all the lines. The systemati variation is at once rendered evident by the marke preponderance of positive or negative residuals. Th results corresponding to the different elements are, o

closer examination, found to be in close agreement with other evidence we have about the differences of level in the solar atmosphere. Lanthanum and cyanogen are usually regarded as low-level constituents, and they are also conspicuous in the present instance in showing consistently low velocities for the solar rotation. This indicates that the period of rotation increases as we approach the surface, or that the outer layers of the atmosphere rotate much more rapidly than those lying close to the photosphere. These facts are in good accordance with the results obtained for hydrogen and the other substances which are characteristic of high levels above the photosphere.

All the observations may be well represented by a slight modification of the Faye formula, showing that it may be applied with great accuracy to determinations of the sun's rotational velocity to within 10° of the pole. The adopted formula for representing the Mount Wilson observations is—

$$\xi = 11{\cdot}04^\circ + 3{\cdot}50^\circ \cos^2 \phi,$$

where ξ is the daily angular velocity, and ϕ the solar latitude. In this connection it is of interest to review

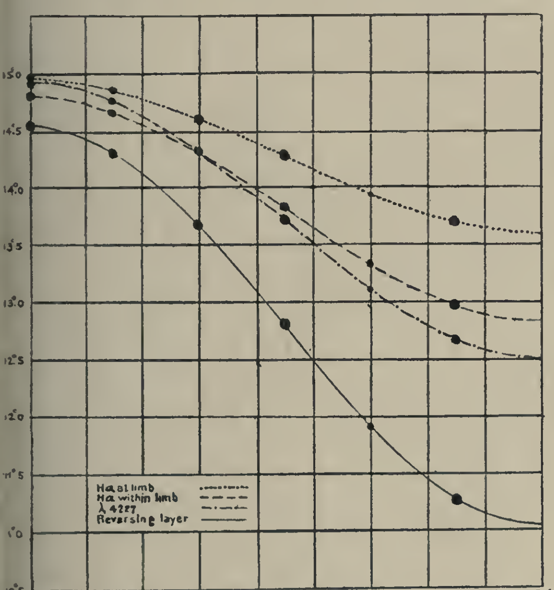


FIG. 2.—Curves representing the values of the angular velocity given by the empirical formulæ derived from the observations of Hα, λ 4227, and the reversing layer. For the last named the mean of the two series of observations is used.

the values of this equation which have been given by some of the more important determinations of the solar rotation made during the last century.

Observer	
Carrington	$\xi = 14{\cdot}42 - 2{\cdot}75 \sin 7/4\, \phi$.
Spoerer	$\xi = 8{\cdot}55 + 5{\cdot}80 \cos \phi$.
Maunder	$\xi = 12{\cdot}43 + 2{\cdot}01 \cos^2 \phi$.
Dunér	$\xi = 10{\cdot}60 + 4{\cdot}21 \cos^2 \phi$.
Halm	$\xi + 12{\cdot}03 + 2{\cdot}50 \cos^2 \phi$.
Adams (mean of two series)..	$\xi = 11{\cdot}04 + 3{\cdot}50 \cos^2 \phi$.
Adams λ 4226	$\xi = 12{\cdot}5 + 2{\cdot}4 \cos^2 \phi$.
Adams Hα	$\xi = 13{\cdot}6 + 1{\cdot}4 \cos^2 \phi$.

It will be noticed that both λ 4227 (calcium) and Hα (hydrogen) give considerably higher rotational velocities than the general elements of the reversing layer. The equatorial acceleration is considerably greater for λ 4227 than for Hα at the limb. The discussion of the numerous results is made much clearer by several diagrams; two of these are here reproduced, showing the main features outlined in this necessarily brief summary of a very extensive investigation. A word of caution is given as to the interpretation of certain results shown by the tables. Thus if the lines showing systematic large or small values of the angular velocity are specially considered, it is seen that there is an apparent increase towards the sun's pole. Comparison of the results found for sun-spots, faculæ, and the calcium flocculi gives the following sequence in order of *decreasing* equatorial acceleration: (1) spots and faculæ, (2) λ 4227, (3) calcium flocculi, (4) Hα. The reversing layer shows a greater amount of equatorial acceleration than any of these.

CHARLES P. BUTLER.

MAGNETIC OBSERVATIONS AT THE COLABA OBSERVATORY.[1]

THE two somewhat formidable volumes referred to below contain a most valuable compilation of observations extending over sixty years, together with a discussion of the results presented in a form in which they can be used in further investigations. Observations on terrestrial magnetism were started at the Colaba Observatory, Bombay, in 1840, but it was not until the year 1846 that regular records were obtained. When it was found that disturbances were likely to be caused by the electric traction which was being introduced in Bombay, it was decided to move the observatory to a more suitable site at Alibág, about eighteen miles away; and after securing duplicate records at the two stations in 1904 and 1905, the magnetic work at Colaba was finally abandoned in 1906. The first volume, extending over 264 pages, contains a complete description of the instruments and processes of reduction. The methods employed are described in great detail—some may think, perhaps, with too great diffuseness—but many interesting points are brought out incidentally. The complete record, for instance, of the monthly values of the magnetic moment of one of the standard magnets, extending over nearly forty years, is probably unique. This magnet does not show any tendency to approach a steady state: it is rather the annual diminution amounting to about the thousandth part of its value which has become steady.

Great attention is deservedly given to the temperature corrections. These were originally determined by means of thermometers suspended on the wall of the magnetometer room, and the corrections were obtained by assuming that the magnets had the same temperature as the walls. This—as is now found—has led to errors. A remarkable discrepancy between the diurnal variation deduced from eye observations taken above ground, and that deduced from the photographic records taken in the magnetometer room, led Mr. Chambers to suggest that the amplitude of the variation might be different according as the magnetometer is placed above or below the surface of the ground. Since the observatory was dismantled Mr. Moos has made a careful comparison of the temperature variations observed by the thermometers on the walls with those recorded by thermometers placed in the exact position of the original magnets, and found —as might have been expected—that the variations here were smaller. Rectifying the previously applied temperature corrections, it was found that the diurnal variations as observed in the two positions became identical.

1 "Magnetic Observations made at the Government Observatory, Bombay, for the Period 1846 to 1905, and their Discussion." By N. A. F. Moos. Part i., Magnetic Data and Instruments. Pp. v+263+plates. Part ii., The Phenomenon and its Discussion. Pp. xiv+vii+iv+265–782+plates. (Bombay: Government Central Press, 1910.)

In part ii. the results are discussed. After a detailed account of the secular and annular variations, the diurnal variations are examined from all possible points of view. The Fourier coefficients are calculated, and the differences between quiet days and the average values for all days are examined. An interesting chapter deals with magnetic disturbances and their effects on the periodic changes; the results obtained seem to be in agreement with those noted in other places. When the curves of different localities are compared, Mr. Moos finds that the progression of an average disturbance appears to be made up of a common pulse which commences everywhere simultaneously, a further change taking about ten or eleven hours to reach its maximum, and finally an accentuated diurnal wave. This last point is of some importance.

The special discussion of quiet days brings out the result that the absolute value of the horizontal force is higher, but that the annual variation is practically the same whether derived from these quiet days or from all days. It is interesting to find that when the quiet days are selected with reference to the magnetic state of the whole earth, the results differ less from the average of all days than when the quiet days are selected by purely local conditions. This result may prove to be of considerable significance to anyone seeking an explanation of the after-effects of a magnetic disturbance, for it seems to show that these after-effects are confined to those parts of the earth which have been affected by the storm.

Special attention must be directed to the chapter which deals with lunar effects. The influence of the moon on terrestrial magnetism—which undoubtedly exists—may either be an atmospheric effect or be due to the tidal distortion of the earth. It is of the highest importance to decide which it is, and for this purpose it is necessary to obtain the lunar variations at a number of different stations. Mr. Moos has done his share of the work for Bombay, but there are too few observatories which give sufficient data to allow a general discussion of lunar effects. The last two chapters deal with the connection of terrestrial magnetism with solar spots and its relation to meteorological and seismic phenomena.

Mr. Moos deserves the highest credit for having undertaken a work of such enormous labour as the preparation of these two volumes must have involved. We have only two criticisms to make. Some credit should have been given to the earlier observers, to whom the observatory of Colaba owes, in the first instance, its deservedly high reputation. Reference ought, for instance, to have been made to the volume published in 1872 by Mr. Charles Chambers, whose name only occurs in connection with a paper on the lunar effect published in the Philosophical Transactions. The second criticism may seem trivial, but is provoked by an unnecessary amount of trouble caused to the reader who looks at the laudably complete table of contents only to find that the references (in the second volume) are all to paragraphs and not to pages. Some of these paragraphs cover a great number of pages, and much irritation is caused by the time spent in turning over page after page until the right paragraph is found. The references should either have been made to pages, or the number of the paragraph should have been printed at the top of every page.

The two volumes, even with their minor faults of diffuseness and occasional obscurities of expression, form a most valuable book of reference, which no doubt will be extensively used by everyone wishing to obtain an insight into the complicated phenomena of terrestrial magnetism.

AGRICULTURAL EDUCATION IN THE UNIVERSITY AND THE SCHOOL.[1]

WHEN the council of the Reading University College decided to develop their agricultural department, they very wisely began by taking stock of the situation, and in view of the report of the departmental committee appointed by the Board of Agriculture to investigate agricultural education in England and Wales, they decided to go abroad for information. For the report confesses that the majority of English farmers are not reached by the agricultural colleges at all; indeed, one witness went so far as to assert that not more than 5 per cent. of the farmers of England are directly affected by them.

Agricultural colleges have, however, gained the confidence of the farmers of Canada and the United States. A deputation appointed by the college therefore visited the Macdonald College, St. Anne de Bellevue; the Central Experimental Farm, Ottawa; the Ontario Agricultural College, Guelph; and the Cornell and Wisconsin Universities in the States, to discover what features these institutions possess that enable them to gain the confidence of the farmer. At all the institutions the question of rural life as a whole is frankly dealt with, and women's courses, as well as men's, are arranged. Taking as a good example the Guelph College: there is a woman's institute where a complete training for rural life is afforded to women; there are altogether thirteen hundred men and women students, a third of whom are taking the full diploma or degree course; and there is so great a bond between the college and the farmer that during June, 1910, more than 40,000 agriculturists visited, or were expected to visit, the plots and demonstrations. In 1909, the college conducted definite experimental work on nearly 5,000 farms. Further, the college has about eleven official missionaries in the province: graduates who are sent out to gain the confidence of the farmer, to advise where possible on agricultural matters, and, above all, to bring the farmer into touch with the college. But the college is only part of a larger scheme. The Government of Ontario has a definite agricultural policy briefly set out in the report, into which we need not enter, except to note that the college is the centre for teaching, experiment, and constructive ideas. "From Guelph go forth to the country the trained farmer, the trained rural teacher, and the trained housewife." The college, however, is in no bondage to its official position, nor does its connection with the University of Toronto give it any airs of superiority or cold academic aloofness; it is closely in touch with its province by countless personal ties and shows a lively and vigorous sense of its responsibility.

With local modifications the same remarks apply to all the other colleges visited. In all cases the college is the centre of agricultural life for its district, and its staff is primarily concerned with the improvement of the local rural life.

Why is it that the Canadian and American colleges have succeeded so well, whilst the English colleges, whatever else they have achieved, have certainly not become the centre of rural life in the country? Partly, the deputation consider, because the English farmer is already highly competent and can only be helped by very able specialists. He has behind him a long tradition, and need look to no one for advice; in Canada and the States, on the other hand, the farmer has usually no tradition and must perforce turn to

[1] Agricultural Education: Report of a Deputation appointed by the Council of University College, Reading, to visit selected centres of Agricultural Education and Research in Canada and in the United States.
Memorandum on the Principles and Methods of Rural Education. (Board of Education, 1911.)

some honest, disinterested source for information; naturally he goes to the college. In England matters have sometimes been made worse by the appointment of rather poor agricultural instructors and by the fact that education is associated in the farmer's mind with heavy county rates.

Thus the success of the Canadian and American colleges, as compared with that of the English colleges, is partly to be attributed to differences in local conditions, and the deputation failed to discover a system that they could transplant here with any hope of success. They learnt much, however, and they applied the experience gained to their own problem at Reading and drew up a scheme for a complete agricultural department. Into the details of the scheme we need not enter; the principles on which it is based, however, seem to us to be very sound. First and foremost they consider that the staff must be competent. "In making any new appointment of major rank it is impossible to exaggerate the importance of securing a first-class man. . . . No proposition receives more lip-homage in educational circles, and perhaps none is more frequently flouted in practice." That a university agricultural department staffed in this way would be eminently successful is beyond dispute, and all interested in agricultural education will hope that Reading will have the means and the courage to go ahead. For as the deputation found out, specialisation is very necessary in agricultural work; indeed, they might have quoted the precisely parallel case of medicine. No college would think of setting up a professor of medical knowledge and one or two assistants as a medical school. Yet most colleges think the arrangement does sufficiently well for agriculture; only one agricultural department has more than one professorship; indeed, at one of our oldest universities even the examinerships are not specialised, one and the same person being required to examine both in agricultural botany and agricultural chemistry!

Passing now to the memorandum on the principles and methods of rural education issued by the Board of Education, it is quite evident that a serious effort is being made to bring the education of the country school into some sort of relationship to the conditions of country life. But in reading through it we are not convinced that the Board has grasped the fundamental difference between the conditions of life, and even the outlook upon life, in the country and in the town. The reader instinctively feels that no new method is being evolved, but the old system (which has not been a conspicuous success in the rural district) is simply making a second appearance in a dress with some agricultural trimmings. The organiser who is responsible for giving rural significance to the schools is at present "primarily an expert in agriculture in the narrower sense, and it will probably always be desirable that this should be the case." But why? Why not men who primarily possess insight and imagination, who can get to the essentials of the problem, and devise methods of dealing with it? However, teachers and country authorities alike realise its importance, and we may be closer than we think to the new rural education.

THE NOTIFICATION OF TUBERCULOSIS.

FOR some time past public opinion has slowly but gradually been educated on the question of the infectivity of pulmonary and certain other forms of tuberculosis. When notification of phthisis as an infective disease was first mooted, a loud outcry was raised, not only by the public, but even by medical men. Certain enlightened communities, however, recognising the importance of such notification, early obtained powers to put into operation a system of voluntary notification. It was argued, and very wisely, that until the medical officer of health and his committee could be put in possession of information concerning centres of infection, little could be done to prevent the dissemination of infective material from these centres. It was maintained, further, that notification, voluntary on the part of the patient and his medical attendant, was preferable to no notification at all, in so far that in the first place some information as to the presence of tuberculous patients would be provided, and, in the second, some experience as to the working of the system would be obtained.

The present chief medical officer of the Local Government Board, even when he was medical officer of health for Brighton, has always been in favour of voluntary notification of tuberculosis, whilst so far back as September, 1908, the present President of the Local Government Board announced during the sittings of the International Congress on Tuberculosis at Washington that he had promoted an order that in workhouses and similar institutions the notification of pulmonary phthisis should be compulsory. Mr. Burns has made the study of tuberculosis peculiarly his own, and the further development of notification and the extension of the compulsory clauses of the Infectious Diseases Notification Act to this disease is but the natural outcome of this systematic study by men keenly interested in the preservation of the public health. Moreover, there is a general feeling that even this is not the last of the measures of preventive legislation to be taken.

It is now recognised that tuberculosis is to be stamped out or cured by no single method or system. The centres of infection are so varied, the phases and types of the disease so numerous, and the condition of the patients so diverse that siege must be laid to tuberculosis in very different fashions, as occasion may require. Only after obtaining a knowledge of the individual cases can those in authority set to work to classify them in such manner that appropriate measures may be taken to meet the requirements of these cases, as they are searched out and examined.

The advanced cases of consumption—patients who are left to linger on, badly fed, wretchedly housed and clothed, weak, distressed, and disheartened—are most dangerous centres of infection, and the only satisfactory way to deal with them is to place them in hospitals where, in comparative comfort, relieved from anxiety as to their shelter and daily bread, segregated as regards infection, but visited by their friends from time to time, they may pass the remaining months or years of their life. Remove these, the most dangerous, cases to hospitals—for they are dangerous so long as they remain amongst their fellows—and they become harmless. For other patients dispensary treatment may be all that is necessary; but as experience is gained many of these will no doubt be sent to sanatoria, partly for initial treatment and rest in order that the cure may begin under the most favourable conditions, and the patient may make a "good start," but also in order that he may be educated in the care of himself, and that he may render himself less dangerous to others with whom he may have to live and work.

During the last fifty years the death-rate from tuberculosis has fallen more than 30 per cent. With proper application of compulsory notification and stern tackling of the problems that it will disclose, at least as great, and probably a still greater, fall of this death-rate may be prophesied at the end of the coming couple of decades.

FOOT-AND-MOUTH DISEASE.

APPOINTMENT OF A COMMITTEE OF INVESTIGATION.

THE recurrence of this disease in England during the present year has been a source of grave concern to all engaged in agricultural and live-stock industries. It is, however, a matter for congratulation to the Board of Agriculture, and its veterinary department in particular, that the disease has been stamped out again with such a comparatively small loss. There have been eighteen outbreaks this year, with 467 animals affected, an approximate average of 26 animals in each outbreak. This is truly remarkable considering that foot-and-mouth disease is probably the most rapidly contagious of all epizootics.

During the four years immediately preceding the present year, there were five outbreaks with 127 animals affected, each outbreak being suppressed in little more than a week, at a total cost of a few thousand pounds. This has only been possible as the result of early diagnosis and the immediate slaughter of all affected and contact animals. The importance of drastic and immediate action can be well realised by noting some of the latest Continental returns. In Germany during August alone there were 37,737 outbreaks of foot-and-mouth disease; in July 12,385 were recorded in Holland, 4,097 in Belgium, and 16,027 in France, where it has been estimated that the loss will amount to more than fifteen millions sterling.

The new Minister for Agriculture has therefore taken a very wise step in appointing a committee, as announced in Parliament last week, "to inquire into the circumstances of the recent outbreaks of foot-and-mouth disease and to consider whether any further measures can be adopted to prevent their recurrence." The committee of twelve is to be presided over by Sir Ailwyn Fellowes, and includes the members of Parliament for South Wilts, St. Patrick's Division of Dublin, Barkston Ash, Carmarthen West, Newmarket, and North Bucks, together with Major E. M. Dunne, Mr. R. Carr, Mr. E. E. Morrison, Mr. E. P. Nunneley, and a member of the Central Chamber of Agriculture. They are to be assisted by the veterinary and administrative officers of the Board.

Of greater importance, however, is the proposal to appoint an expert scientific committee to proceed to India, where the disease is unfortunately very rife, to investigate the special characteristics of the disease, its etiology, the means by which it is contracted and spread, and practicable means of prevention. It is to be hoped that tangible results will be attained, so that we can continue to enjoy the markets of the world for our live-stock, as the result of the freedom of these islands from such animal scourges.

DR. W. SUTHERLAND.

IT is with regret that we have observed the report of the sudden death, on October 4, of Dr. William Sutherland, at his residence, Stawell Street, Melbourne, as recorded in *The Melbourne Age*. Dr. Sutherland was born in Scotland in 1859. At the age of ten he went with his parents to live in Melbourne. He obtained a Government exhibition, and finished his preliminary education at Wesley College. From there he went to the University, where he took his Master of Arts degree, obtaining the highest honours each year in mathematics. The winning of the Gilchrist scholarship in his final year enabled him, under the terms of the exhibition, to go to London University College. He was then only twenty years of age. Three years later he returned to Australia, having obtained a degree in science.

From that time until his death Dr. Sutherland devoted himself entirely to original scientific research. He contributed papers to scientific periodicals in America, England, and on the Continent. His first line of thought led him to inquire into the molecular constitution of matter in its various phases of liquids and solids. Later he devoted attention to the subject of viscosity. His papers, which appeared mainly in *The Philosophical Magazine*, are well known to the scientific world. They are distinguished by great width of reading in the latest phases of the subjects he treated, combined with very bold speculation always brought into ample comparison with experimental knowledge. His greatest success was the discovery, in 1893, of the relation connecting the viscosity of a gas with the temperature; the result of a very ingenious, though not quite demonstrative, theoretical argument, and amply confirmed by all subsequent work. His writings were copious in all problems connected with molecular physics, whether they concerned laws of attraction between molecules, the nature of emulsion in its physiological ramifications, the application of electrons and of electrochemical ideas to the properties of matter, the molecular structure of water, or many other subjects. His generalisations were, indeed, so numerous that it was often a difficult task to try to estimate their value. Although Dr. Sutherland had thus contributed a large number of papers to various scientific journals, he never published anything in book form. He preferred to devote his energies entirely to original work and research. For a period he discharged the duties of professor of physics at the Melbourne University during a temporary absence of the occupant of the chair; but in the main he preferred freedom and control of his time. His relations with the University staff were cordial and intimate. He was an examiner at the University and at the College of Pharmacy, and was also connected with the scientific work of the School of Mines.

J. L.

NOTES.

WE are informed that Dr. Glazebrook, the director of the National Physical Laboratory, who has been seriously ill since the end of September with enteric fever, is now making satisfactory progress. After so long an attack of fever his recovery must necessarily be somewhat slow, and it may yet be some little time before he can be regarded as convalescent; but there is good reason to hope that the recent marked improvement may be maintained.

THE case of the *Hawke* and *Olympic* collision, which is now before the Admiralty Courts, is directing considerable attention to the influence of passing vessels upon each other, particularly when those vessels are travelling in the same direction at speeds not differing greatly from each other. Experiments are now being made at the William Froude Tank of the National Physical Laboratory, with models of the *Hawke* and *Olympic*, to test whether such an influence was present and acting at the time of the collision. The president of the Admiralty Court and the various counsel paid a visit to the experiment tank on Saturday last and witnessed a large number of experiments with the models. These were of wax, and were towed from the carriage, or bridge, which spans the large waterway of the tank. The general theory of the influence of passing ships upon each other is the outcome of the "stream-line" theory of the late Prof. Rankine; and we hope to give a fuller account of this shortly.

AN earthquake of unusual strength was felt on November 16 at about 9.25 p.m. (Greenwich mean time) in the south of Germany, throughout Switzerland, and in

the east of France and the north of Italy. It was followed by two others of less importance early on November 17, one shortly after midnight, the other at about 3 a.m. The reports so far available in this country are singularly meagre. There does not seem to have been any loss of life, but slight damage to property occurred in several places, such as Constance, Stuttgart, Freiburg, Mülhausen, and Hechingen, and, though it is difficult to credit the statement, at Munich. Leaving the last-named place out of account, the area of slight damage is about 140 miles long from east-north-east to west-south-west, and 90 miles wide, and contains about 10,000 square miles. The centre may have been about 10 miles to the north of Schaffhausen. The shock was felt so far as Dresden, 310 miles from this point, so that the disturbed area may have contained as much as 300,000 square miles. It is thus probable that the focus was situated at some depth. The vibrations were recorded at several distant observatories—in this country at Shide and West Bromwich. At Heidelberg, Besançon, and Potsdam the recording levers were deranged or broken.

A DISCOVERY of remarkable prehistoric burials has been made by the Broadstairs Archæological Society in the grounds of a private school. During excavations a series of Saxon graves came to light. Under these, and therefore of an earlier date, were found a number of graves arranged round a circular trench, in which the bodies had been buried with the arms and legs flexed. Nothing was found to give a clue to the date of these circular burials; but Mr. F. G. Parsons, who is making an examination of the bones, is of opinion that they belong to the Bronze age. Whatever the antiquity may prove to be, the find is one of importance, for we know very little of the inhabitants of Kent prior to the Saxon period. The remains, which are somewhat fragmentary, are to be placed in the museum of the Royal College of Surgeons, where they may be compared with other finds of a similar nature which have been made in the south-east of England. In the current number of the Journal of the Royal Anthropological Institute (vol. xli., p. 101) Mr. Parsons gives an interesting description of Saxon remains found in a cemetery near Folkestone.

FURTHER details of the Wright gliding experiments are now to hand. On Tuesday, October 24, the best flights were made in the teeth of a wind which was recorded by a gauge raised 12 feet from the ground to be blowing at 50 miles an hour. Orville Wright made nineteen successive glides, one, the last, enduring for 9m. 45s., and extending over a distance of nearly a quarter of a mile. During his seventeenth glide he remained stationary in the air for 5m. 11s., the whole glide lasting 7m. 15s. The following day twenty glides were made by Orville Wright and Alexander Ogilvie, but as the wind was slight nothing remarkable was achieved. On October 26 twenty-four flights were made, one of which lasted 2m. 15s. This was the last day before breaking up the camp. The new automatic stability device, which had arrived, was not fitted to the machine, and its trials were postponed to a later date. To the description of the machine used, given in NATURE of November 9, the following details may be added:—As the cutting-down of the skids necessitated the removal of the "blinkers," a vertical surface or keel-plane was fitted to the front edge of the main planes immediately to the right of the pilot, the object being to keep the glider directly head on to the wind. Furthermore, a boom projecting in front of the main planes some five feet carried a bag of sand, as the pilot's weight was insufficient to keep the machine level in high winds.

PROF. W. H. PERKIN, F.R.S., and Prof. E. Rutherford, F.R.S., have been elected corresponding members of the Munich Academy of Sciences.

THE Institute of Chemistry announces that Mr. Bertram Blount will deliver the second lecture on "Cement" at King's College, Strand, W.C., on Friday, December 1.

PROF. ANDREW MCWILLIAM, professor of metallurgy in the University of Sheffield, has been appointed by the Government of India to the newly created post of metallurgical and analytical inspector of steel in India.

WE learn from the *Revue scientifique* that the German Society of Aërial Navigation has constructed at Feldberg, in the Schiefergebirge, a geographical observing station for the study of aërial currents, and for the issue of a service of wind warnings.

THE council of the Royal Meteorological Society has awarded the Symons gold medal to Prof. Cleveland Abbe, of the United States Weather Bureau, in recognition of the valuable work which he has done in connection with meteorological science. The medal will be presented at the annual meeting of the society on January 17, 1912.

WE learn from *Science* that Mr. Waldemar Lindgren, who has been connected with the U.S. Geological Survey since 1884, and since 1907 has been in charge of the investigations of metalliferous deposits and of metal statistics, has been elected chief geologist, in succession to Dr. C. Willard Hayes.

THE Société Française de Physique has arranged a series of nine lectures on "Modern Ideas on the Constitution of Matter," by Madame Curie, Profs. Langevin, Perrin, Weiss, and other distinguished physicists. They are to be delivered on Saturday evenings during the next four months either at the Sorbonne or at the rooms of the society, and are open to all members of the society. The example set by the French society might with advantage be followed by some of our societies.

AT a meeting of the executive committee of the British Science Guild, held on November 15, it was announced that arrangements were being made to hold occasional evening meetings of the members, at which papers or lectures would be read, to be followed by discussions. Also further papers have been received on the subject of the conservation of the natural sources of energy, and it is hoped to publish this report before the close of the year. The subjects of coordination of charitable effort and postal reform were also discussed.

ON previous occasions we have referred to the mining operations made this year by the Duke of Sutherland to determine if the gold deposits in the Kildonan district of Sutherland could be worked at a profit. In our issue of September 28 (vol. lxxxvii., p. 425) we announced that information received from the field showed the experiments had been a financial failure. The report of Mr. William Heath, the expert entrusted with the operations, has now been commented upon in the Press. Mr. Heath says:—"This field cannot be worked by any method so as to realise on the most liberal estimate anything like half the working expenses."

THE president of the Royal College of Surgeons, Sir H. Butlin, delivered at the college two lectures (November 13 and 15) on "The Parasite of Cancer." Sir H. Butlin maintains that the cancer cell is a new creation, an independent organism most closely resembling a protozoon,

which lives as a parasite in the body of the animal which is suffering from cancer. He apparently does not suggest that it is a parasite derived from without, but that the host by some inscrutable means has fashioned it out of its own tissues.

THE death is announced, in *The Times*, of Dr. W. W. Webb, at Exeter, in his fifty-fourth year. Dr. Webb resided for some years at Netley, and was appointed curator of the Natural History Museum at the Royal Victoria Hospital, being awarded the Martin memorial gold medal and the Sir Joseph Fayrer's prize for pathology at Netley in 1883. He was the author of a guide for intending candidates for commissions and for junior officers of the Indian Medical Service, a manual of vaccination, and a work on the currencies of the Hindu States of Rajputana.

MR. JOSEPH COLLINSON, writing from the Animal Friend Society, asks for protection for the badger, as this sadly persecuted animal has dwindled down almost to extinction. Many well-known landowners have made praiseworthy efforts to protect the badger, and warmly advocate his preservation. "The protection of the badger," remarks Sir Harry Johnston, "ought to be made universal in the law of the land, quite as much as in the case of interesting wild birds," a sentiment which will receive the approbation of all who are interested in preserving the wild fauna of their native country. No other animal has made such a wonderful struggle for existence; and it is hoped by Mr. Collinson that protests may be made in time to prevent his total extermination.

THE second International Congress of Entomology will be held at Oxford on August 5–10, 1912, under the presidency of Prof. E. B. Poulton, F.R.S. Further particulars will be announced shortly. The executive committee proposes to find for members of the congress lodgings in the town, or rooms in one or more of the colleges at a moderate charge; rooms in college will be available only for men. The executive committee invites an early provisional notice of intention to join the congress, in order to be able to make the arrangements for the necessary accommodation. The proceedings of the first congress are in the press and will be published shortly. All communications and inquiries should be addressed to the General Secretary of the Executive Committee, Dr. Malcolm Burr, c/o the Entomological Society of London, 11 Chandos Street, Cavendish Square, London, W.

IT was suggested at a meeting of the Anglo-German Friendship Society, held at the Mansion House on November 2, under the presidency of the late Lord Mayor, that an Anglo-German Exhibition should be held in London in 1913. We learn from *The Times* that the idea has been favourably received, and an influential committee has been formed to forward it, under the presidency of the present Lord Mayor, consisting of the Lord Chancellor, the Duke of Argyll, Lord Brassey, Lord Avebury, Lord Weardale, Lord Courtney of Penwith, Lord Shuttleworth, Sir Frank Lascelles, Sir West Ridgeway, Sir Vezey Strong, Sir William Mather, Sir Ernest Tritton, Mr. Harry Lawson, M.P., and Mr. Alfred de Rothschild, with Mr. Cyril Rhodes, the honorary secretary of the Anglo-German Friendship Society, as honorary secretary.

THE London meeting of the Institute of Metals will be opened at the Institution of Mechanical Engineers on Tuesday, January 16, when the president-designate, Prof. W. Gowland, F.R.S., will deliver his inaugural address on the subject of "Copper and its Alloys in Early Times." The whole of Wednesday, January 17, will, if necessary, be devoted to the reading and discussion of a number of papers, amongst which may be mentioned the following:—Properties of certain copper alloys at high temperatures, G. D. Bengough; further experiments on the inversion at 470° C. in copper-zinc alloys, Prof. H. C. H. Carpenter; the influence of oxygen on copper containing arsenic or antimony, R. H. Greaves; the nomenclature of alloys, Dr. W. Rosenhain; poisoned brass, and its behaviour when heated in vacuo, Prof. T. Turner; and a paper by Dr. Carl Benedicks, of the University of Stockholm, dealing with some novel experiments on a zinc-antimony alloy.

WE regret to record the death of Mr. Eugene William Oates, at Edgbaston, on November 16, at sixty-six years of age. Like many other Indian officials, Mr. Oates, who served (chiefly, we believe, in Burma) for thirty-two years in the Public Works Department of India, devoted his leisure time to the study of the ornithology of the country in which he was long resident. His earliest ornithological work appears to be a "List of the Birds of Pegu," published in Calcutta in 1881, and a couple of years later appeared his "Handbook to the Birds of British Burmah, &c.," published in London, in two volumes. This was followed, in 1898–9, by a "Manual of the Game Birds of India," which likewise formed two volumes, and was published at Bombay. Somewhere about this time he appears to have retired from the service of the Indian Government, for in 1889–90 his name appears as editor of the second edition of Mr. A. O. Hume's "Nests and Eggs of Indian Birds," published, in three volumes, in London. His knowledge of Indian ornithology led Dr. Blanford to select Mr. Oates to write the first two volumes on birds in the "Fauna of British India," which appeared respectively in 1889 and 1890; and later he was engaged by the trustees to compile the "Catalogue of Birds' Eggs in the British Museum," the first volume of which was issued in 1888 under his own name, while in the other three this appears in conjunction with that of Captain Savile Reid. Mr. Oates's knowledge of Indo-Burmese ornithology was very extensive, and his work careful and elaborate.

THE committee of the British Antarctic Expedition has made an earnest public appeal for further contributions towards the support of Captain Scott's expedition in Antarctica. Through ill-fortune, unforeseen expenses have been incurred. On her voyage south after leaving New Zealand on November 29, 1910, the *Terra Nova* experienced terrible weather, and the damage done to the ship has entailed a heavy bill for repairs; and the cost of new stores to replace those lost on this voyage has to be met. After defraying these unexpected disbursements the money left will be hardly enough to enable the committee to pay until the end of March, 1912, the allowances of the wives and relatives of the officers and men of Captain Scott's party. On these accounts alone the committee must somehow raise more money. In addition, however, it is imperative that there should be no delay in securing further funds if the honour of first reaching the South Pole is to be secured for Captain Scott. The *Terra Nova* on her journeys unexpectedly came across the Norwegian expedition under Captain Amundsen, who also is trying to reach the Pole. The committee asks for 15,000*l*. by December 1, so that a telegram may be sent before the *Terra Nova* sails south to reassure Captain Scott that the necessary funds will be forthcoming. We agree with the committee that it would be pitiful if Captain Scott and his party were allowed to fail for want of financial support. We are confident that the appeal to the patriotism of our men of

wealth will not be in vain, and that the honour of this country in the world of science and exploration will be maintained by the generosity of the wealthy men at home and the efforts of the men of action now in south polar regions. Contributions should be sent to the treasurer, Sir Edgar Speyer, at 7 Lothbury, London, E.C.

THE advantage of the application of physiological knowledge to the problems of Egyptian archæology is shown in a clever explanation of the origin of the representation of an ancient standard found on the slate palette of King Narmer, which was discovered at Hierakonpolis, in Upper Egypt. It appears again in a specimen of the twelfth dynasty unearthed by Prof. Flinders Petrie below the palace of Apries, at Memphis. Dr. C. G. Seligmann and Miss M. A. Murray, in the November number of *Man*, point out that this curious figure represents the placenta, which is still, according to Mr. J. Roscoe, held in reverence by the Baganda, as it is supposed to contain the external soul of the chief, and is hence preserved at his birth. It was carried in procession by a special official, because the safety of the reigning sovereign was believed to depend upon its being carefully preserved.

IN the first part of the Journal of the Royal Anthropological Institute for the current year, Prof. A. Keith examines a collection of skulls, principally those of Negroes from the Congo Free State and Nigeria. These constitute four groups: those from Nigeria, the Congo, the Korawp, on the frontier of the German Cameroons, and a group of tribes including the Ekoi and Kabila of Nigeria, and the Fortit and Bongo of the Nile region. From the present distribution of the Negro tribes in equatorial Africa, Prof. Keith comes to the following conclusions:—There has been free intermigration; in the course of their evolution, the tendency of one tribe has been towards the accentuation of one set of characters, of another towards another set. Thus the Dinka acquire high stature and narrow heads; the typical Nigerians low stature and narrow heads; the Basoko wide, short heads and low stature; the Buruns wide heads and high stature. Interbreeding may have played its part; but if it had played a great part we should have found greater physical uniformity than there is. The influence of Arab blood on these tribes has probably been exaggerated.

THE Bulletin of the Johns Hopkins Hospital for September (xxii., No. 247) contains articles on Zabdiel Boylston, inoculator, and the epidemic of smallpox in Boston in 1721, by Dr. Fitz; medical notes on the "Divine Comedy" of Dante Alighieri, by Dr. Dernehl; and on "Molière and the Physician," by Dr. Kahn. A new department has been created in the Johns Hopkins University, to be known under the general title "Art as Applied to Medicine." Its purpose is to bridge over the gap existing between art and medicine, and to train a new generation of artists to illustrate medical journals and books. The instruction given is designed for the needs of two classes: (1) for medical students, and (2) for artists. The department is in charge of Prof. Max Brödel, and a synopsis of the two courses is given.

A REPORT by Dr. F. J. H. Coutts, on an inquiry as to condensed milks, has been issued by the Local Government Board. It contains much important matter on the history, methods of manufacture, composition, and use of condensed milk, with suggestions as to administrative control, labelling, &c. Condensed milk occurs as full-cream or machine-skimmed, and may be sweetened, partially sweetened, or unsweetened. The composition of the different brands varies somewhat; *e.g.* in the full-cream and fully sweetened the fat varies from about 9·0 to 13·7 per cent., and the sucrose (generally beet sugar) from 37·2 to 41·5 per cent. The condensed milks, except occasionally in the unsweetened brands, which are sterilised, generally contain some micro-organisms (up to several thousand per cubic centimetre), but they show no disposition to multiply either in the unopened or in the opened tins, as a rule. Diluted condensed milk, however, becomes a favourable medium for the growth of bacteria. The process of condensation appears to be fatal to the tubercle bacillus. The importance of condensed milks is in connection with infant feeding. The skimmed condensed milks are to be absolutely condemned for this purpose, owing to the small fat content. Infants fed on condensed milks seem to suffer from more infantile ailments, and the mortality is higher among them, than among those fed on cow's milk. As regards cost, the condensed milks are slightly more expensive than equivalent amounts of cow's milk and sugar. The labelling of some of the brands is very misleading to the poorer and illiterate mothers who principally use them. It is suggested that the skimmed brands should be labelled as unfit for infant feeding, and that some declaration of the content of fat and of substances foreign to milk should be obligatory on the labels.

A SIGNED portrait, accompanied by a memoir, of the late Mr. G. H. Verrall, the distinguished authority on British flies, forms the chief feature in the November number of *The Entomologist's Monthly Magazine*.

IN referring to his bird-marking experiments in the November number of *British Birds*, Mr. Witherby remarks that "the number of birds marked has steadily increased until this year the splendid total of just 9500 has been reached. In the first year of the inquiry only 2200 rings were used, but in the next year 7900 were placed, so that the number of birds 'ringed' by the readers of *British Birds* now amounts to nearly twenty thousand." The large increase in the number of rings implies, of course, increased expenditure, to meet which additional contributions are solicited.

IN its report for the year ending June 15, 1911, the Northumberland Sea-fisheries Committee gives a summary of the results of the experiments in marking fish and crustaceans which have been carried on locally during the last few years, together with tables and charts. The experiments in breeding lobsters show that an abundant supply of absolutely pure sea-water is essential to success; and it is interesting to note that during the year one of the officials had the opportunity of observing a lobster during the process of shell-changing. Experiments on Holy Island show that a vast area is available for the culture of mussels, to be used either as bait or food; and observations are also recorded on the spawning of cod.

To *Naturwissenschaftliche Wochenschrift* for October 29 Dr. A. Kobelt contributes a long article on the physiological origin of markings and colour in the animal kingdom. Attention is directed to the prevalence of pigment in the neighbourhood of the great sensory and nervous structures, as exemplified by the dorsal stripe of many mammals and some lizards, the dark lateral line of fishes, the frequency of dark markings on the muzzle, and especially the concentration of colour in the eye and its neighbourhood. The hue of the ground-colour of animals is attributed by the author to the existence of an equilibrium between the effects of light-stimulus and the influence of the sense-organs, which leads to an equality in, and a large

increase of, the sensory cells. Disturbance of this equality gives rise to colour-markings. Apparently Dr. Kobelt does not believe in protective coloration.

THE Purdue University Experiment Station has taken a leaf out of the business man's book, and freely advertises its results among farmers. The Bulletins, a number of which are to hand, are written in a manner likely to attract, and demonstrate that the yield of maize can be considerably increased on the ordinary farm without a great expenditure, but solely by the adoption of improved varieties or better fertilisers. New crops have been introduced, and improved and more economical rations have been drawn up for dairy stock.

WE have received from the United States Department of Agriculture, Bureau of Entomology, catalogue by E. R. Sasscer of recently discovered Coccidæ and by D. Moulton of the North American Thysanoptera, and also an annotated bibliography of the Mexican cotton-boll weevil by F. C. Bishopp. Publications of this type are extremely valuable in enabling investigators to find their way through the appalling number of entomological publications that are put out at a rate probably unequalled in any other subject.

The National Geographic Magazine for September is largely devoted to two studies of Troglodytes, one by Mr. F. E. Johnson describing those of southern Tunisia, the second by Miss E. H. Brewer the cave-dwellers in Cappadocia. Some French officers divide the Tunisian Troglodytes, whose presence in that region is noted by the historian Sallust into three groups: those living in excavations in the ground, those occupying caves or holes in the hillside, and those living in houses superimposed one upon the other, the higher chambers being reached by precarious staircases or stones projecting from the walls. The Troglodytes in the Uskub Valley in Asia Minor occupy holes excavated in curious rock cones. Prof. Sterrett, of Cornell University, who has studied them, believes that this form of dwelling dates so far back as the Hittite period. Both these accounts of two remarkable races are illustrated by a series of admirable photographs.

IN the *Zeitschrift der Gesellschaft für Erdkunde* (No. 7) Dr. A. Rühl discusses the part played by isostasy in the formation of peneplains. He considers that when an elevated land mass is subjected to long-continued erosion the isostatic equilibrium is destroyed, and as a result, after a greater or less period of time, a new upward movement will take place, but to a less extent than originally. Local conditions will determine at what stage these isostatic movements will occur. The development of the earth's surface would not be a continuous operation, but rather one strongly periodic in character in which short periods of active orogenetic and epeirogenetic movement would be succeeded by relatively long periods of erosion. Orogenetic movements occurring would cause fracturing of the earth's crust, and eroding agencies would become active, removing material and redepositing elsewhere. This will destroy the isostasy, and sooner or later a warping or tilting of the whole land mass will occur.

PART iii., vol. xli., of the Records of the Geological Survey of India contains the usual annual statistics of the mineral production of India, the year here dealt with being 1910. Upon the whole, the production is just about stationary, the value of the output showing an increase only of some 12,000*l.*, whilst its total is 7,700,000*l.* The principal item, as before, is coal; the total output is just over 12 millions of tons, showing an increase of about 177,000 tons over 1909: on the other hand, prices have fallen again to about what they were before the boom of 1907–8, and may be looked upon as at about a normal level. The industry is evidently in a sound condition: the output per miner shows a satisfactory increase, and exports have gone up and imports have gone down by 43 and 36 per cent. respectively. Owing to the above-noted fall in price, the value of the coal output in 1910 is 324,321*l.* lower than in 1909; but, as explained, this is a healthy symptom so far as the coal industry is concerned. The next most valuable output on the list is that of gold, which is practically stationary at 2,200,000*l.* These two minerals are by far the most important amongst Indian mineral products, accounting for about three-fifths of the total value. The production of manganese ore shows a fair increase, the total for 1910 being just over 800,000 tons; prices were also rather better than they were in the previous year, so much so that whilst the quantity produced was increased by 20 per cent., its value was increased by no less than 40 per cent. The production of both mica and petroleum has fallen off during the year under review. Upon the whole, it may be said that whilst not chronicling any brilliant results, the statistics before us show a steady progress in the mining industry of our Indian Empire.

THE excessive rains of Saturday and Sunday last have occasioned considerable and extensive floods at many places in the south and east of England, and in Kent and Sussex a great deal of land is under water. The Weather Report issued by the Meteorological Office for the week ending November 18 shows that the total rainfall for the period was largely in excess of the average over the entire kingdom. The heaviest falls occurred in Scotland and Ireland, where in parts the rainfall for the week was about three times the average amount. Falls of more than an inch in twenty-four hours occurred in all parts of the kingdom; and at Worthing the measurement for the three days ending November 18 was 3·27 inches. The autumn rainfall for the eleven weeks commencing with September is now in excess of the average in all districts except in the north and west of Scotland, the north-east of England, and the Midland counties. The greatest excess for the autumn is 3·00 inches in the Channel Islands, which is followed by 2·85 inches in the south of Ireland and 2·73 inches in the south-east of England. The greatest deficiency of rain since the commencement of the year is 6·56 inches in the Midland counties, where the aggregate fall, so far, is only 16·53 inches. The temperature last week was largely in excess of the average in all the English districts, the excess amounting to nearly 5° in the east of England. The duration of bright sunshine was generally deficient.

THE meteorological chart of the North Atlantic for November issued by the Deutsche Seewarte gives an interesting account of a hurricane experienced on July 12 in the South Atlantic, near lat. 30° and long. 30°, by four out of five sailing vessels which left Chilian ports between May 17 and June 14, the tracks of which are laid down for the whole voyage to the English Channel. It is noteworthy that the storm occurred with a relatively high barometer; the synoptic charts drawn for July 10–13 show that a shallow depression lay over the coast of central Brazil on July 10, and that on the following day it had divided into two parts, the centre of one being on the coast in 20° S. and the other in about 26° S., long. 39° W. From the chart of July 12 it appears that the two systems had coalesced, and had travelled in a south-easterly direction. The atmospheric conditions are considered to be very striking (notwithstanding that it was the southern winter),

the more so as the disturbance proceeded from the somewhat low latitude of 20° S.

THE marine turbine speed-reducing gear fitted by the Westinghouse Company, of Pittsburg, to the United States collier *Neptune* is described in *The Engineer* for November 17. This is a modified form of the Melville-Macalpine gear with double-helical pinion and spur wheel. The power transmitted is 4000; the pinion keyed to the turbine shaft runs at 1250 revolutions per minute, and the screw shaft at 130—a reduction of nearly 10 to 1. The pinion shaft is not carried in rigid bearings, but is borne in a long sleeve, which is provided with three hydraulic pistons above and three below. The movement from the central position is trifling—two or three thousandths of an inch—but the liquid correction gives the gear a certain amount of elasticity, reduces shock and noise, and conduces to the sweet running of the gear. The *Neptune* has given great satisfaction on its trials.

WITH the view of ascertaining the resistance of reinforced concrete strong-rooms to attack by oxy-acetylene blow-pipes, tests were recently made on a slab prepared by the Indented Bar and Concrete Engineering Company, of Westminster. The results are described in *The Engineer* for November 17. The oxy-acetylene blow-pipe was applied to the slab for twenty-four minutes, at the end of which period, after much raking out of the resulting glass formed by the fusion of the sand, and accompanied by a deafening roar from the blow-pipe, a hole 3·5 inches in diameter was made through the slab. Whenever a steel bar was met the metal-cutter, *i.e.* a stream of pure oxygen directed on to the white-hot steel, was brought into action, and the steel instantly fused away. The concrete was the material which gave the trouble, the metal-cutter being powerless to act upon it. The same thickness of steel of any grade could not have resisted the metal-cutter longer than about four minutes. The test slab was 6 inches thick; 0·55 cubic foot of oxygen and 0·45 cubic foot of acetylene were consumed in the test, which clearly is strongly in favour of reinforced concrete as contrasted with steel.

A COPY of the Year Book for 1911 of the Indian Guild of Science and Technology has been received. The object of the guild is to cooperate in promoting the knowledge and application of pure and technological science in India with a view to the improvement of the methods of economic production and the amelioration of the sanitary condition of the people. Prof. Smithells, F.R.S., is the general president of the guild; and among the list of patrons we notice the names of Sir Henry Roscoe, F.R.S., Sir William Ramsay, K.C.B., F.R.S., and Prof. O. N. Witt. The year book runs to 135 pages, and contains an official report of the annual general meeting, held on December 19, 1910, of the activities of the various sections, and the speeches at the annual dinner. In addition, a number of scientific articles, many of them concerned with pressing Indian problems, are included. Altogether the guild, which is only in the third year of its existence, has entered upon a career of great usefulness.

MESSRS. NEWTON AND CO., 3 Fleet Street, E.C., have just issued a supplementary list of lantern-slides, in which several sets of slides of scientific interest are included. Among these subjects are remarkable examples of achievements of photography, pictures taken by Prof. R. W. Wood with ultra-violet and infra-red rays, photographs of snow crystals taken by Mr. W. A. Bentley, wild flowers, glaciers, and other scenes in Switzerland, and architectural hygiene.

OUR ASTRONOMICAL COLUMN.

THE SPECTRUM OF BROOKS'S COMET, 1911*c*.—With the three-prism slit spectrograph (No. iii.) and a small objective-prism spectrograph of 10 cm. focal length, both attached to the Pulkowa 30-inch refractor, Prof. Belopolsky secured several photographs of the spectrum of Brooks's comet during October. Eight hours' exposure with the slit spectrograph on October 4, 5, and 6 showed the bands 473 $\mu\mu$ and 431 $\mu\mu$ clearly, and others faintly; in each case the several maxima in each band were measured, and the wave-lengths are given to six figures. Measures of the radial velocity of the comet gave +15 km., agreeing with the ephemeris.

With the smaller spectroscope monochromatic images of the comet were found at 560, 516, 473, 405, and 388 $\mu\mu$, each image being sharply defined on the red side; special measures gave the values 388·36 $\mu\mu$ and 387·52 $\mu\mu$. Bands in the continuous spectrum extended from 420 to 421 $\mu\mu$ and from 402 to 405 $\mu\mu$. On October 1 the bands were equal in intensity, but on October 10 that at λ 388 was the brightest; this band only gave a faint trace of the tail (*Astronomische Nachrichten*, No. 4535).

THE CHEMICAL UNITY OF THE COSMOS.—In the current number of *Scientia* Prof. Fowler has an interesting article in which he sums up the evidence showing the chemical unity which exists among all the bodies of the visible universe, so far as our present means permit us to examine them. Kant and Laplace suggested such a unity; but it was not until Kirchhoff and Bunsen, in 1859, supplied the key which opened up to us celestial spectrum analysis that the suggestion could be practically tested. Several factors still interfere in many cases with the proof of absolute coincidence of wave-length in comparing radiations in different spectra, but Prof. Fowler believes that all celestial spectra will sooner or later come within the scope of laboratory reproduction. Most of the strong lines in the solar spectrum are already origined, and the sun has been shown to take its place in an orderly sequence of stellar forms. Then, again, the study of the various elements, under varying laboratory conditions, initiated by Sir Norman Lockyer, has provided us, so far as the main variations in celestial spectra are concerned, with terrestrial parallels for the stellar departures from the sun's spectral features.

SUN-SPOTS AND FLOCCULI IN 1910.—In addition to the values for December, 1910, No. 12, vol. i., of the *Boletin Mensuel del Observatorio del Ebro* contains the *résumé* of the solar and meteorological observations made during 1910. The spot areas were low throughout the year, and no spots were recorded at all in August, September, and December. The reduced area for spots, in both hemispheres for the whole year, was 165 millionths of the solar hemisphere, and for flocculi the analogous value was 401 hundred-thousandths, the ratio between the two being 24·3. Taking the hemispheres separately, the values for the northern was 42, and for the southern 123, millionths for spots, and 114 and 287 hundred-thousandths for flocculi. The mean heliographic latitude of spots was 10·1, and for flocculi 10·2. During the year there were 301 groups of flocculi occurring with spots and 525 occurring without, and the tabulated summary shows that those groups occurring with spots were decidedly of a more compact character than those occurring without.

ASTROGRAPHIC CATALOGUE, PERTH (W.A.) SECTION.—In the preparation of the International Astrographic Catalogue the section dec. −31° to −41° was allotted to the Perth Observatory, West Australia, which has just published the first volume of results. The complete measures will occupy thirty-six volumes; and the present issue, the first to be completed, is vol. iv. The method of work is briefly explained by Mr. Cooke, but a general introduction will appear later. It is believed that the faintest stars shown on the centre of the Perth plates are of about mag. 11·5, those at the extreme corners 10·5; and the present volume contains the measures of the rectangular coordinates and magnitudes of 13,636 star images between R.A. 18h. to 24h. on plates with centres in declination −32°.

THE CASE-HARDENING OF STEEL.

THE autumn meeting of the Iron and Steel Institute was to have taken place in Turin, but unfortunate circumstances rendered this impossible. None the less, a series of important papers by Italian authors were presented—and taken as read—at the meeting held recently in London. Most of these papers were of the nature often met with at foreign meetings of this institute—*i.e.* records of metallurgical resources and achievements of the country. On this occasion, however, two Italian papers of a different character were laid before the institute. These deal with the case-hardening of steel, and are both from the pen of the well-known Turin metallographer Prof. F. Giollitti, whose name proclaims his close relationship to the present Prime Minister of Italy.

The two papers in question are entitled "On Case-hardening by Means of Compressed Gases" and on a "New Industrial Process for the Case-hardening of Steel." The striking fact brought out by these papers is that the Italian metallographers who have worked on this subject have evolved order out of chaos by treating the whole question as one of physico-chemical equilibrium between the various solids and gases present during the process. It is to be regretted that Prof. Giollitti did not carry out his avowed original intention of giving a detailed summary of the more important researches on this subject conducted by him and his collaborators at Turin, but the mere bibliography of some fifteen memoirs is sufficiently impressive. The results of these researches are, however, summed up by the author in his present paper in a series of conclusions which are very definitely laid down. If we may accept Prof. Giollitti's statement that his views are fully established, the fundamental facts of case-hardening are as follows:—

(1) Solid carburising agents, without the intervention of gases, have only a slight action.

(2) The specific effect of nitrogen is very weak, and only in the presence of cyanides, ferrocyanides, &c., does the effect of volatile nitrogen compounds become marked.

(3) The specific carburising effect of carbon monoxide is enormously greater than that of any solid cementing agent. Pure carbon monoxide carburises iron at all temperatures between 700° C. and 1300° C., and it produces a greater depth of carburisation in a given time than any other carburising agent. Both the depth and intensity of the cementation can be accurately regulated, as they are governed by equilibrium conditions, which can be definitely ascertained and adhered to.

(4) The use of carbon monoxide as the principal cementing agent makes it possible to obtain softer and better graded cementation than is obtainable by other means.

The new industrial process which Prof. Giollitti bases on his experimental results is, in effect, a specially mechanically arranged furnace, which makes it possible to charge and discharge a vertical muffle with the articles to be case-hardened in a very short time. So soon as the muffle is charged with the steel, which is introduced at a red heat, the remaining free space of the muffle is filled with hot granulated carbon, which, the author tells us, flows into the interstices like a liquid. Then a current of carbon monoxide or of dioxide is passed in at a measured rate for a definite time and at a measured temperature, and any desired degree of hardening can be obtained. The effect of the direct contact of the steel with the solid granular carbon appears to be the production of a thin outer skin of very highly carburised steel, while the effect of the gases gives a less highly carburised region extending for some depth into the metal. In the Giollitti muffle it is possible to withdraw the solid granulated carbon at any desired stage, and to continue the cementation with the gas alone, merely leaving enough carbon in the muffle to secure equilibrium of the gases (CO and CO_2) with solid carbon. Tables of analyses are given which show that the result of such treatment is somewhat to lower the carbon concentration of the extreme outside layer and to reduce the carbon concentration gradient inwards to almost any desired extent. This treatment, therefore, removes the risk of cracking and shelling which arises from the rapid changes in carbon content which occur in articles case-hardened in the ordinary way, and more especially by the use of cyanides or ferrocyanides. By the new method it is claimed that cementation of very great depth can be safely obtained, even with special alloy steels, which tend to become "rotten" on the surface when cased by other means. Whether the Giollitti muffle and method will realise all these expectations practical experience alone can show, but there is no doubt that these Italian investigators have thrown a flood of new light into a formerly obscure region of steel metallurgy.

The character of this new light is perhaps more clearly shown, so far as the scientific point of view is concerned, in the paper by Giollitti and Carenvali on case-hardening in compressed gases. The work described in this paper is based on the researches of Schenk on the equilibrium of the systems consisting of Fe, C, CO, and CO_2; Fe, Fe_3C, CO, CO_2; Fe, FeO, CO, CO_2, and other systems consisting of the mutual compounds of the elements iron, carbon, and oxygen at various temperatures and pressures. The experiments of the present authors were conducted by means of a small electric resistance furnace placed inside a steel cylinder, and partially filled with both granular carbon and steel specimens, into which compressed carbon dioxide was fed at known rates. The authors found, in general, that the rate of cementation increased with the pressure employed, but they also found that when certain pressures were exceeded, in spite of their intimate contact with incandescent solid carbon, the surfaces of the steel specimens became thickly coated with oxide, although vigorous cementation had taken place in the metal immediately beneath the oxide layer. Thus they show the photomicrographs which are reproduced in Figs. 1 and 2; in No. 1 we see the section of a carbon steel close to the surface, which was covered with a thick layer of oxide, and the highly carburised nature of the steel close to this surface is at once evident. In No. 2 we see the section of an alloy steel (in this case a nickel-chrome steel) which exhibits an altered, highly carburised layer close to a deeply oxidised surface; the magnification in both cases is 65 diameters.

FIG. 1.

FIG. 2.

In the case of chrome-steels such a paradoxical result had already been observed by Charpy, who expressed his results by stating that apparently in the action of carbon-monoxide on iron-chromium alloys the two metals behaved independently, the iron becoming carburised, while the chromium is oxidised. The present authors show that such an opinion is not justified; the explanation of the apparent paradox lies in the equilibrium conditions of the systems referred to above. For every temperature and concentration there is a critical pressure above which oxide, as well as carbide, of iron is present in equilibrium with CO, CO_2, and C. The addition to iron of a baser metal, such as chromium or manganese, lowers this critical pressure

until—in certain alloys—it falls below the ordinary atmospheric pressure, and oxidation as well as cementation takes place. On the other hand, the addition of a "nobler" metal, such as nickel, raises the critical pressure and allows of the use of gases under higher pressures for cementation without risk of spoiling the articles by surface oxidation. Two interesting conclusions are drawn by the authors. The first is that for a given steel there is a limiting pressure for cementation, by means of carbon-carbon-monoxide mixtures, beyond which surface oxidation sets in. The second is that in the case of chromium alloy steels the pressure of CO and CO_2 must be diminished below atmospheric to allow of cementation without oxidation. Since it is only the partial pressure of these gases, however, which comes into effect, this diminution below atmospheric pressure can be produced by simple dilution. It follows, and the authors describe an experimental verification, that in these circumstances oxidation can be avoided by diluting the stream of "cementing" gases (CO and CO_2) with air. The oxygen, of course, combines with the granulated carbon in the furnace to form CO and CO_2 in the proportions required by the equilibrium conditions, while the remaining nitrogen acts as a diluent and produces the desired effect.

We have here a series of remarkable deductions and experimental verifications of facts which appear almost incredible to any steel-worker not conversant with the theory of physico-chemical equilibria; indeed, the practical man will probably find it difficult to believe them until he has tried for himself. None the less, there is here a basis for the rational and scientific conduct and control of a process hitherto largely based on "rule of thumb."

W. ROSENHAIN.

THE INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.[1]

THE annual volume of the Transactions of the Institution of Engineers and Shipbuilders in Scotland, which at the close of the session 1908–9 had 1650 members upon its roll, contains several valuable papers. The president, Mr. C. P. Hogg, in his address, after passing in rapid review some of the outstanding developments in engineering during the past 100 years, directed attention to some of the problems of the future; in his opinion the nineteenth century demonstrated how to utilise the forces of nature, while the problem of the twentieth century will be how to do so efficiently.

Mr. C. A. Ablett in a paper on electrically driven reversing rolling mills described in detail the Ilgner system, in which the power, supplied under very economical conditions by a steam turbine or a gas engine, is applied to drive a reversing mill. The mill motor is a direct-current shunt-wound machine; interposed between it and the source of power supply is a fly-wheel converter set in order to provide a system by which the mill motor may be started, stopped, reversed, and kept under control in regard to speed without loss of energy, and at the same time to enable a control apparatus of reasonable dimensions to be employed. The electrical equipment of a 36-inch cogging mill at Osnabrück was described as an example of this system, and the paper was illustrated by a series of drawings and photographs of the plant; especial attention was given to the flexible coupling between the fly-wheel and the electrical machines of the converter set.

In the discussion on this paper Mr. T. B. Mackenzie expressed the opinion that German steel makers were able in many cases, owing to their skilful utilisation of waste energy, to roll their steel at lower rates for power than usually obtained in this country; he believed that in the steel works of the future there would be no reciprocating steam engines employed—the whole of the power needed would be generated by gas engines in a central station and distributed electrically to the various mills.

In a paper by Mr. A. Melville, the "Simplex" method of concrete pile foundations was described; the essential principle of this system was the driving into the ground of a 16-inch diameter steel tube closed at the lower end either by a loose point or a pair of hinged jaws, which open when the tube is eventually withdrawn and permit concrete, either plain or reinforced, to be passed through, filling up the entire space originally occupied by the tube simultaneously with the withdrawal of the latter from the ground. This system has now been extensively employed in the United States, and is rapidly coming into use in this country; the cost was stated to be about 2*s.* 6*d.* per cubic foot of pile when no reinforcement was used.

The important problem of the design of surface condensers, more important than ever since the introduction of the exhaust steam turbine, was dealt with in a paper by Mr. R. M. Neilson, who stated that empirical methods must be abandoned, and the area of cooling surface calculated in a rational manner so as to allow a given vacuum to be guaranteed under given conditions. The author proceeded to work out a scheme for the design of condensers, allowing for the varying conditions found in practice, and then offered a series of valuable suggestions as to the most profitable lines on which experimental research might in the future be conducted. In the discussion Prof. Mellanby directed attention to Dr. Stanton's researches into this problem, and Mr. Weir pointed out that in a condenser for a turbine-propelled torpedo-boat he was able with a vacuum of 28·7 inches to secure a condensation of 27 lb. per square foot of cooling surface.

Other papers published in this volume are steamship repairs by electric and autogenous welding, by Mr. H. S. Younger, descriptive of processes by which repairs can be carried out either by electric welding or by means of the oxy-acetylene process on damaged material so as to make it serviceable again; some tests on board ship to ascertain the water consumption of engine-room and deck auxiliaries, by Mr. C. F. A. Fyfe; and Prof. Mellanby's description of a new experimental steam engine at the Glasgow and West of Scotland Technical College.

T. H. B.

[1] Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol. liii. Fifty-third session, 1909-10. Edited by the Secretary. Pp. xxxii+429 (Glasgow: The Institution, 1910.)

TICKS.[1]

THE rapid advance that has been made in recent years in scientific and medical knowledge with regard to diseases caused by parasitic Protozoa and other microscopic organisms has had the secondary result of directing attention to the insects or other invertebrate animals which are often the agents in the dissemination of the disease-causing parasites. Mosquitoes, tsetses, and other biting flies, fleas, and other ectoparasites are now being collected eagerly and studied earnestly in all parts of the world, less perhaps by professed zoologists than by medical men and others, to whom the practical importance of these pests is a greater stimulus to investigation than the purely scientific interest which the creatures may possess in themselves. Hence special attention has been directed to the various groups of blood-sucking arthropods so soon as their connection with particular diseases has been made known. Mosquitoes were the first to come into prominence when their connection with malaria was discovered; then biting flies, and especially tsetse-flies, when their *rôle* in disseminating trypanosomiases of animals and human beings was made known; and next fleas have been the subject of close study, when their relation to the spread of plague became apparent. There remain three important groups of ectoparasites: ticks, lice, and bugs. It is well known that ticks play a considerable part in spreading diseases. In human beings, African relapsing fever is caused by a spirochæte transmitted by a tick; hence its popular name of "tick-fever." In animals, various deadly diseases, known collectively as "piroplasmoses," because caused by a minute blood-parasite belonging to the genus Piroplasma, or allied genera, are known to be transmitted by various species of ticks; such are the "red-water" or "Texas-fever" of cattle, and similar diseases of horses,

[1] "Ticks, a Monograph of the Ixodoidea." By G. H. F. Nuttall, C. Warburton, W. F. Cooper, and L. E. Robinson. Part i., Bibliography of the Ixodoidea, by G. H. F. Nuttall, L. E. Robinson, and W. F. Cooper. Price 6*s.* net. Part ii., by G. H. F. Nuttall and C. Warburton. Price 12*s.* net. (Cambridge University Press, 1911.)

dogs, and other domestic animals in various parts of the world.

For the medical or veterinary practitioner, who cannot be expected to be an expert in every branch of science as well as in his own art, it is of the highest importance that the scientific knowledge of the ectoparasites that are likely to disseminate diseases should be brought together and summarised in such a manner as to be accessible to those whose vocation brings them into contact with these pests. Exhaustive monographs of the various blood-sucking invertebrates are of the greatest practical as well as scientific value. The work under review is the first attempt to deal in this manner with ticks, a somewhat repulsive group of arachnids which has attracted the special attention of but few professed naturalists, and of which the literature, though considerable in bulk, is extremely scattered, and much of it inaccessible. Consequently, experts on this group have been rare, and the identification of a species has often been a matter of extreme difficulty.

The main results of the labours of Prof. Nuttall and his colleagues will be to collect together all references to works dealing with ticks, and to give accurate descriptions, accompanied with illustrations, of every valid species of tick in such a way that it will be possible for anyone in any part of the world to identify a tick, of a species already known, by aid of this monograph. The undertaking is therefore one which, if successfully carried out, will fill a great gap and render an important service.

The first two instalments of the monograph are before us. Part i. contains the bibliography of ticks, which covers 68 quarto pages of references. The bibliography is printed only on one side of the paper, so that those who wish to keep it up to date can cut it up and make a card-catalogue of it. Part ii. contains two sections, the first dealing with the classifications of ticks, the second with the genus Ixodes, Latreille, 1795, of which fifty-one valid species are recognised. Following the descriptions of these species, of which all but two are accompanied by illustrations, are notes on the geographical distribution, on doubtful species, and on the biology of Ixodes, and a synonymic list of condemned and doubtful species, together with a list of the collections in which the types are to be found.

A detailed criticism of this work could only be undertaken by an expert writing for experts. We note, however, that the bibliography seems to contain a great many references to works, ancient and modern, which are little more than literary curiosities, and it would, we think, have been useful to separate the chaff from the wheat by indicating in some way those references which advance the scientific knowledge of the group and are to be taken seriously. For our part, we are sceptical as to the utility, in a work of this kind, of references to the opinions of Aristotle, Pliny, and Moses. The fact that the ancients believed ticks to be without an anal aperture may be an interesting "tit-bit," but it is not of much value, scientific or practical, to those who wish to study ticks at the present day. The illustrations are good and very clear, and the work seems singularly free from misprints. Prof. Nuttall has a curious fancy for using inverted commas, in some cases not for quotations, apparently, but for familiar expressions, such as "rattled like peas" or "put in the way of finding their food"; if these are quotations we do not recognise them, nor are we put in the way of finding their source.

A work of this kind tends, by aiding investigation and discovery, to hasten the advent of the period when it will itself be out of date. It makes it easy for anyone to collect ticks, to identify them, and to discover and describe new species; hence long before it is completed it will probably require supplements. The study of these parasites, interesting not only to the practical man, but also to the naturalist, as remarkable instances of adaptation to a mode of life which is peculiar, if to ourselves unpleasant, will be greatly advanced by the publication of this monograph; and both classes of investigators will owe a debt of gratitude to the labours of Prof. Nuttall and his collaborators for raising the scientific knowledge of ticks to a plane in which rapid progress is rendered possible in the future.

SEISMOLOGY AT THE BRITISH ASSOCIATION.

WE have before us the sixteenth report of the Seismological Committee of the British Association. There may be reasons why this particular report should be known as No. 16, but for those interested in seismological literature such a title may be misleading. As a matter of fact, this association has published fifty-two annual reports about earthquakes, some of which, like those by the late Robert Mallet, are reference works for all who are students of seismology. I direct attention to this matter as an indication that Great Britain has not been behind in investigations relating to earth physics. In certain directions it is far in advance of many others.

The first fact to be gathered from this report is that the British Association, in its endeavour to make a seismic survey of the world, enjoy the cooperation of about sixty stations, which are fairly evenly distributed over the surface of our earth. It is remarkable to note that colonial Governments, and particularly cable companies, have established observing stations on many oceanic islands, as, for example, at Cape Verde, Ascension, St. Helena, Fernando Noronha, Mauritius, Seychelles, Cocos, Fiji, and other places. On March 28 this year the Legislative Council of Bermuda passed a "Seismographic Act" enabling the Board of Public Works to purchase and maintain instruments for recording earthquakes. Other colonial Governments have taken similar steps; whilst the English Government gives direct assistance to an International Association which has its headquarters at Strassburg. An item of considerable interest in the report refers to Double and Multiple Earthquakes, about which we read the following:—

"Attention has frequently been drawn to the fact that an earthquake as it radiates may cause a collapse of strata which is in an unstable condition, and thus give rise to one or more secondary disturbances. The great earthquake of Lisbon in 1755 gave rise to secondary shocks in England, Ireland, and probably in many other countries. In the volume containing Physical Observations made in the Antarctic Regions in 1902–3, published under the superintendence of the Royal Society, p. 92, I gave illustrations of secondary earthquakes the genesis of which corresponded in time with the arrival of two particular phases of primary disturbances. That the third phase or the large waves of a seismic disturbance as they travel round the world, causing the crust of the same to rise and fall like a raft on an ocean swell, should give rise to one or more secondary disturbances is not surprising. Farther than this, any of the latter which may be *greater or less* than their parent may in turn become the originator of farther settlements. *One megaseism may therefore cause a relief of seismic strain throughout the world.*"

Of multiple earthquakes a number of illustrations are given. If the interpretation put upon them is correct, it means not only a help to those who wish to analyse seismograms, but a considerable advance in our knowledge of what is taking place beneath our feet. A shake in one place means a shake in many, and it may be added that the *foci* of these are probably in that region where cooling is taking place most rapidly.

In another section of the report we read about the "Synchronism of seismic activity in different regions." For example, it is found that during the last 300 years the times of activity in Italy, although separated from each other by irregular intervals, have varied between five and twenty years, and that these dates of activity in Europe closely corresponded with dates when there had been marked activity in Japan.

Under a section headed "Megaseismic Frequency" we see that between the years 1899 and 1909 there had been 508 world-shaking disturbances in winter months and 468 in summer months, which practically means that there are as many large earthquakes at one period of the year as at any other.

In connection with seismological work, measurements have been made of the deflection of the vertical by the tidal load of the Solent. At Ryde, close to the sea front, it was found that a 10-foot tide caused a deflection of

0·85″. At Bidston, two miles from high-water mark, a similar tide caused a deflection of 0·2″. From these observations inferences have been made bearing on the selection of sites for an observatory, the difference in elasticity of different types of rock, and other matters.

Reference is also made to tidal-load experiments carried out in Pennsylvanian railway tunnels, and to observations made by Mr. J. J. Shaw with horizontal pendulums in collieries in the Midlands.

Following this are catalogues of strong shocks which have occurred in the United States of America, Peru, and Chile, together with epitomes of unpublished notes relating to destructive earthquakes received from Secretaries of State of the Foreign, Colonial, and India Offices. All these will be of use, not only to the seismologist, but also to the man of business.

Lastly, we have a peculiar catalogue, probably the first of its kind. For want of space it only refers to the five years 1899–1903. For these years it gives all the world-shaking earthquakes, whether they originated on land or beneath an ocean. The times at which each disturbance originated, and the latitude and longitude of its epicentre, are specified. Dual or multiple earthquakes are linked by brackets, and the positions of origins are shown on a map. Inasmuch as this catalogue refers to reliefs of strain throughout the whole world, and not simply to earthquakes which have occurred on land surfaces, it seems possible that it may be used as a basis for new investigations.

A note at the end of the report shows that although records obtained on smoked surfaces are extremely good for large disturbances, they fail to record very small movements, which possibly may represent disturbances which were large at their origins.

A communication from Prof. H. H. Turner was a note on the periodigram of earthquake frequency. The conclusion arrived at was that no period of from seven to twenty years existed, or was shown in the materials which he had examined. These materials, however, only referred to large earthquakes which had originated on or near to land surfaces.

Mr. Maxwell Hall communicated a paper on the solar cycle: the Jamaica rainfall and earthquake cycles. The earthquakes observed in Jamaica closely followed the periods of sun-spot activity.

A paper by Mr. Napier Denison, of Victoria, B.C., has been referred to separately (NATURE, November 2).

JOHN MILNE.

SOME RECENT WORK ON SEX.

AT the Portsmouth meeting of the British Association there were several communications to Section D (Zoology) relating to recent work on sex, an account of which is subjoined.

Mr. Geoffrey Smith referred to the theory he put forward at last year's meeting to account for the effect of the parasite Sacculina upon the sexual characters of its host, the crab Inachus, according to which the development of adult female characters in infected crabs of both sexes was held to be due to the production in excess of a yolk or fatty material in the blood similar to that which is stored in the ovary of a normal adult female. Mr. Robson's work (see below) shows clearly that the presence of Sacculina profoundly influences the fat metabolism of its host. Mr. Smith has made observations on the fluctuations in growth of the comb of fowls, which demonstrate the close connection between fat metabolism and the development of the female characters. Measurements show that the combs of hens are continually fluctuating in size, the changes being rapid and between wide limits; a comb may increase 200 per cent. in area in three weeks. It was found that such rapid increase of the comb invariably took place just before a period of egg-laying began. The hen's comb is composed of two walls of fibrous and vascular tissue, between which is a loose core of connective tissue, which at the period of egg-laying becomes infiltrated with fat, and to this cause is due the sudden increase in the mass of the comb. This increase takes place when the ovary is storing up large quantities of yolk, *i.e.* when large amounts of fatty material are being conveyed in the blood to the ovary. Here, then, is another instance of a simultaneous effect upon the ovary and a secondary sexual character brought about by the presence of an excess of fatty material in the blood. Mr. Smith suggested that this case is analogous to that of Inachus infected with Sacculina.

Mr. G. C. Robson described observations, made recently by him in Naples, to test Mr. Smith's theory that Sacculina stimulates the production in the host crab of a yolk-forming substance similar to that developed in the normal female and stored in the ovary at the time of sexual maturity. He examined the blood of the crab Inachus, and especially the lipochromes, which, by reason of their solubility in fat, may be regarded as evidence of the presence of fat. He found a large quantity of fat in the blood of sexually mature females with ripe ovaries, and also that the amount of fat in the blood of infected Inachus was considerably greater than that in the blood of non-infected males and immature females. The blood of moulting individuals of both sexes was also found to have a high fat content, but not so high as in infected examples and breeding females. An increased fat content was also registered in the liver of infected crabs, and there was strong presumption that this was also the case in the breeding female. Mr. Robson also dealt briefly with the changes in colour in the blood lipochromes, and suggested that in all probability the fate of infected crabs is death from starvation, owing to their inability to obtain enough foodstuff of fatty nature for their own immediate needs.

Dr. Cresswell Shearer gave an account of his recent investigations on the archiannelid *Dinophilus gyrociliatus*, collected at Plymouth. This species produces two kinds of eggs, some small, destined to give rise to the small and rudimentary males, others almost six times as large, and also more numerous, which give rise to the large females. The two kinds of eggs are laid together. In a few days the males hatch full-grown and sexually mature, while the females leave the egg in a small and immature condition; just previous to leaving the egg-capsule they are fertilised by the small males. Sections of females at this stage show the sperms collected on the ventral side of the gut at the junction of stomach and intestine, *i.e.* where the future ovary will appear, but as yet no trace of the latter is visible. The ova appear much later, when the female has grown very considerably in size. Shortly after the female germ cells appear, each is seen to be joined by a spermatozoon, the head of which becomes imbedded in, or attached to, the nuclear wall. Ultimately the nucleus of each primitive ovum is composed of two portions, one derived from the spermatozoon, the other from the female cell. These two elements do not fuse, but retain their individuality throughout the various oogonial divisions (about forty to fifty in all). In the majority of these divisions the male and female portions of the nucleus divide equally, so that a similar amount of nuclear material, both male and female, goes into each daughter cell. Now and again, however, the female half of the nucleus seems to divide before the male portion, so that the latter is, as it were, left behind, and is shut off entirely from one of the daughter cells. Of the two resulting daughter cells one has, therefore, the whole of the male part of the original nucleus and its share of the female part, while the other has its share of the female part only. This appears to be the sex-determining factor, for of the two daughter cells the former, which has its share of the female and the whole of the male element, becomes the female egg, while the latter, which has a portion of the female nucleus only, becomes a male egg. Both kinds of eggs, once the sex-determining division has taken place, grow rapidly, absorbing and building up into themselves other immature egg cells with which they come into contact, and in which the divisions of the two portions of the male and female nuclear substance have been equal. The outcome of this process is that the female egg is fertilised, but the male egg is not fertilised in the ordinary sense of the term; but it is impossible to speak of it as really unfertilised, as it has been directly under the influence of the spermatozoon in all the oogonial divisions previous to the sex-determining one. It is only in the late stages, shortly before the female egg is laid, that the two parts of the nucleus fuse beyond recognition.

Prof. C. J. Patten discussed the vernal-plumage changes

in the adolescent blackbird and their correlation with sexual maturity. He held it to be an unsafe procedure to determine the maturity of a bird by its plumage markings; the testes should also be examined macro- and microscopically. He agreed that, as a rule, there is no difficulty in distinguishing the male blackbird in its first spring plumage from the adult of the corresponding time of the year, for the former is usually dark brownish-black with a blackish beak, and the latter jet-black with a yellow beak. But Prof. Patten had specimens in which the yellow coloration of the beak appeared during the first year, coupled with plumage so nearly approaching jet-black that, on general inspection, the bird might pass as being fully mature, the yellow beak being usually regarded as the last sign of maturity. In the birds just mentioned the yellow pigment was developed precociously, and its development outstripped in time the assumption of the true adult plumage, which would not follow until the next year. The testes were 5 mm. long and 2·6 mm. broad, while those of mature birds taken at the same time (the first two weeks in March) were 18 mm. and 10 mm. respectively. In the former there was no sign of spermatogenesis. Prof. Patten concluded that the adolescent blackbirds above described would not have reached maturity until next spring, despite the fact that the beaks were yellow.

THE LAKE VILLAGES IN THE NEIGHBOURHOOD OF GLASTONBURY.[1]

THE second season's exploration of the Meare Lake Village by the Somersetshire Archæological and Natural History Society began on June 5, and was continued for three weeks under the joint supervision of Messrs. A. Bulleid and H. St. George Gray. The ground excavated was situated in the same part of the village, and was directly continuous with last year's work.

The digging included the examination of the remaining portion of Dwelling-mound VII., the whole of Mound VIII., and portions of Mounds IX., X., and XI.

With reference to the construction of the above mounds, two, *i.e.* Mounds VIII. and IX., had special points of interest, and call for mention here. Taken as a whole, however, this part of the work has been up to the present time somewhat disappointing, as little additional information has been gained regarding the structure generally apart from that already acquired at the Glastonbury Lake Village.

Mound VIII. was of medium size, consisting of five floors and situated north-east of Mound VII. No hearth was discovered associated with the two uppermost floors, which were separated with much difficulty throughout. An interesting series of eight superimposed baked clay hearths was, however, found belonging to Floors iii., iv., and v., surrounded by thick layers of fire-ash. The hearths varied from 2 feet 6 inches to 5 feet 3 inches in diameter.

Mound IX. was of large size, consisting, apparently, of two floors, and was only partially examined. Below the clay was a thick layer of black earth composed of charcoal, fire-ash, and débris containing quantities of bones of animals and fragments of pottery. Under the black earth a well-preserved platform of timber was disclosed, bordered by the remains of the wattled wall of a circular dwelling. This timber was chiefly arranged in a north-east and south-west direction, and by far the larger number of the wall-posts were made of squared oak, a feature not hitherto noticed in the dwellings previously examined.

The relics discovered this season were scarcely so numerous as last year. A summary of them is appended.

Bone.—The bone objects were not very numerous. The most interesting specimen is a smooth pin without head, having a long recess, or notch, along the middle of the shaft. A similar object was found with late Celtic remains on Ham Hill, South Somerset (Taunton Museum), and another on the Roman site at Iwerne, Dorset (Pitt-Rivers Museum, Farnham, Dorset). The other specimens include two tibiæ of horse (sawn and perforated), two large polishing-bones, pins, a dress-fastener, part of a drill-bow, and two objects of worked bird-bone.

Worked Carpal and Tarsal Bones of Sheep or Goat.—A large number of "bobbins" and other objects, showing signs of considerable use, have been found, especially in Mound VII., where so many weaving appliances were discovered. Many of these bones are perforated in different directions; others have transverse markings, some deeply grooved and very smooth.

Worked Shoulder-blades of Ox and Horse.—At the end of last season no fewer than thirty-two of these objects had been found, all in Mound VII. Four more were collected from the same dwelling this year, and two others in adjacent mounds. Two of those found in Mound VII. are ornamented with large examples of the dot-and-circle pattern. In all instances the bones are smooth, and the longitudinal spine had been cut down considerably. Many of them are perforated at the articular end (probably for suspension). They have been found where weaving implements are abundant, but their use remains to be explained.

Crucibles.—Fragments of two found this year.

Bronze.—Fifteen objects of this material were uncovered this year, but no fibulæ are included. There are three finger-rings, one ornamented by a cable pattern, two rivets (one of a new type), an awl, three thin moulded bosses, part of a belt-fastener, and a large part of the bordering of a perishable scabbard, including the bulbous chape. Perhaps the most interesting remains of bronze is a pair of pins with disc-shaped heads and arched stems.

Flint.—In addition to a number of flakes, a scraper and two or three finely worked knives have been found.

Glass and other Beads.—The beads are numerous and varied. Nine were found last season; eighteen specimens this year. The collection includes two polished bone ring-beads. Six of the beads are of a yellow opaque glass and two pale blue (also opaque). One of the finest specimens is a ring-bead of clear sea-green glass, and two are dark blue. A small blue bead is ornamented round the sides by a continuous wave pattern; two globular beads of clear white glass are ornamented in yellow, one by a spiral device, the other by a herring-bone pattern. The smallest bead is little more than one-eighth of an inch in diameter.

Antler.—The numbered objects of this material have now reached the total of seventy-three, twenty-four being found this season, including three antlers of roe-deer, one bearing knife-cuts, another being shaped as a knife-handle. Nothing of exceptional interest has been found this season, many being pieces of cut antler impossible to name. The two hammers found have not been perforated for fitting handles. Several examples of the so-called "cheek-pieces," perhaps used in connection with the bridles and bits of horses, have been found; but the precise use of many of these objects is very doubtful, and their shaping and perforating vary very considerably.

Weaving-combs of Antler.—Again we have a fine series, bringing the former number of twenty-one up to a total of thirty-five. Mound VII., which must have been a weaving establishment, contributes no fewer than twenty-nine of the number. No dwelling in the Glastonbury Lake Village produced more than nine of these combs. One example is dentated at both ends with twelve and thirteen teeth respectively. The largest, having ten teeth, is 7¾ inches long. Several of them are ornamented with transverse and oblique lines, and one, at least, with dots and circles.

Iron.—The objects of iron are mostly fragmentary, and much corroded, as usual. The "finds" include a chisel, knife, file, and an awl in its handle of antler; also an earth-anvil. The latter was found on the top floor of a mound, and only a foot deep below the flood-soil, through which, owing to its weight, it may probably have sunk subsequently to the occupation of the village.

Kimmeridge Shale.—Objects of this material have this season been increased from twelve to twenty-one, and they are more numerous than in the neighbouring village of Glastonbury. These objects are parts of lathe-turned arm-

[1] Report presented at the Portsmouth meeting of the British Association (Section H) of the committee appointed to investigate the lake villages in the neighbourhood of Glastonbury in connection with a committee of the Somersetshire Archæological and Natural History Society. (Drawn up by Messrs. Arthur Bulleid and H. St. George Gray, the directors of the excavations.)

lets, with three exceptions, viz. a set of three roughly cut heavy rings, which may have been used in connection with horse-harness. In section, one of the armlets (half) measures no fewer than 21 mm. by 16 mm.

Lead and Tin.—Last season three net-sinkers of lead were found, to which one has been added this year. The first object of tin has been found, viz. a small whorl (? bead) ornamented with encircling lines of small punch-marks.

Querns.—Compared with the Glastonbury Lake Village these are plentiful at Meare; but the circular rotary querns are rare as compared with the saddle-shaped specimens, of which some well-preserved examples have been found.

Other Stone Objects.—Parts of circular blocks of stone have been found, slightly recessed on one face and having a narrow rim; they show signs of intense heat, and may be parts of moulds for casting thin bronze. A large assortment of stone hammers and whetstones has been found.

Sling Bullets.—Several of the baked clay sling bullets typical of the period have been collected. Under the clay floors of the mounds three groups of selected ovoid stones were discovered, the numbers being 99, 182, and 347 respectively.

Spindle-whorls.—The former number of twenty-three has this season been increased to forty-three. Most of them are formed from discs of lias; a few are of baked clay, two being very large.

Pottery.—Shards of pottery have been very numerous—some three or four hundredweights. All of them have been scrubbed and preserved, being sorted under the numbers of the dwellings. Several complete pots may probably be built up some day. The proportion of ornamented fragments is high as compared with those from the neighbouring village, and a great many new and highly ornate designs have been added to the collection. Very little ornamented pottery was discovered in the deepest layers, and much of it bearing typical late Celtic designs was found just under the flood-soil. The coarser plain pots were generally found in the black earth and brushwood below the clay floors.

Human Remains.—Two pieces of skull and one bicuspid tooth.

Animal Remains.—Found abundantly. The perforated boars' tusks and canine teeth of large dog were no doubt used as personal ornament. The enormous number of bones of young animals indicates that the inhabitants of this marsh village must have been great meat-eaters. The remains of beaver and otter are frequently met with, and also a considerable number of bird-bones.

LEGISLATION AGAINST INSECT PESTS AND PLANT DISEASES.[1]

THE effort to secure national legislation to keep out new and dangerous insect pests or plant diseases which may be brought in with imported nursery stock has been actively favoured by the U.S. Department of Agriculture, just as the department in the past has promoted and secured legislation enabling it to exclude from the country diseased animals or to quarantine and stamp out animal diseases whenever such have appeared. In the case of domestic animals, the exercise of these powers has brought enormous benefit, and has worked entirely satisfactorily to the livestock industry. It is reasonable to believe that like benefits to fruit and forest interests, including the nursery business, will undoubtedly come from similar legislation to exclude insect pests and plant diseases.

The immediate danger which led to the recent effort to secure legislation was the discovery in 1909 of the abundant importation and wide distribution into the United States of nursery stock infested with brown-tail moth nests and occasional egg masses of the gipsy moth. During the years 1909 and 1910 such infested stock was carried into twenty-two States, covering the country from the Atlantic seaboard to the Rocky Mountains. During the first of these years no fewer than 7000 winter nests of the brown-tail moth, containing approximately 3,000,000 larvæ, were found in shipments into New York State alone—seed material enough to infest the whole United States within a few years. During the second of these years 617 of these nests were found on nursery stock shipped into the State of Ohio, and a much larger number, approximately the same as the year previous, were again sent into New York. Smaller numbers of these nests, proportioned to the amount of nursery stock received, were sent into other States east of the Rocky Mountains during both these years. Fewer brown-tail moth nests were received during the season just ended (1910–11), owing to the agitation in this country and more strict supervision by foreign Governments.

[1] From Circular No. 37 of the U.S. Department of Agriculture.

So far as possible, this stock, as voluntarily reported by customs officers and railroads, has been examined and the brown-tail nests removed or destroyed by State authorities, or, where these were not available, by agents of the Bureau of Entomology of the United States Department of Agriculture. Undoubtedly many shipments have not been reported or examined, and it is quite probable that local infestation has already started at different interior points. The history of both the gipsy and brown-tail moths in New England shows that these insects may be present for several years without being noticed, slowly gain headway, and then suddenly develop their full power of destructiveness.

It is scarcely necessary to comment on the danger from the careless introduction and wide distribution of these two orchard and forest pests. In a limited district in New England more than a million dollars a year have been spent for a long period in a mere effort to control these two insects, and the General Government is now appropriating three hundred thousand dollars annually to endeavour to clear them from the border of main highways and thus check their spread. These expenditures do not take into account the actual damage done, but they do serve as a measure of the danger to the whole country from the recent distribution of these two insects on imported nursery stock.

As further illustrations of the constant risk from lack of legislation may be mentioned two very recently introduced insects which will undoubtedly prove very expensive pests in future years. The European alfalfa leaf-weevil, on the authority of the entomologist of the Utah Experiment Station, Mr. Titus, was probably brought into Utah on packing of nursery stock or other merchandise from Europe. This leaf-weevil has already destroyed much of the value of the important alfalfa crop of Utah, and is spreading into adjacent States. The other illustration is the Oriental cotton scale (*Pulvinaria psidii*), probably the worst scale pest of citrus and other subtropical plants in southern Asia. This scale insect has recently been introduced into Florida on imported stock, and is already well established there.

New plant diseases, against the entrance of which there is at present no bar, may even more seriously jeopardise the farm, orchard, and forest products of this country. Imported potatoes from Newfoundland are now bringing in the potato wart disease, which, wherever it has been introduced in Europe, and also in Newfoundland, puts a stop to potato culture. The importation of white-pine seedlings is now bringing in the European white-pine blister rust, which, if established and disseminated, will destroy much of the value of our white-pine forests. Absolute quarantine against these two plant diseases is the only means of keeping them out. The chestnut disease, now practically shown to have been introduced on trees imported from Japan, illustrates what may quickly happen from such unchecked introductions.

More than half of the important insect enemies and plant diseases now established in the United States have been brought in on imported nursery stock, and new insect enemies and new diseases are being thus introduced every year. Twenty different insect pests, new to the United States, some of them very formidable in the Old World, have been intercepted in the inspections of the imported material by this department this year, and this does not include the introduction of brown-tail moth nests and other European pests with imported seedling stock.

A properly enforced quarantine and inspection law in the past would have excluded many, if not most, of the

foreign insect enemies and plant diseases which are now levying an enormous annual tax, amounting to several hundred million dollars, on the products of the farms and orchards of the United States.

In spite of the many pests which have already gained foothold, and the control of which will be a permanent annual charge on production, there remain many other insect pests and plant diseases with equal capacity for harm which, fortunately, have not yet come in; and it is to protect from these new dangers that legislation is now sought, not with the intention of prohibiting the trade in imported stock, but to throw such safeguards around it as will most protect both the importers and the subsequent purchasers of such stock.

The insect pests and plant diseases that have come in are probably here for all time, but certainly no reasonable objection can be made to the effort to safeguard the future. The conscientious importer will be benefited, and the home producers, the dealers, and all the great fruit and forest interests will be protected by suitable inspection and quarantine legislation.

The San Jose scale had become established in California on stock introduced from China about 1870, and was known to be one of the most serious of orchard pests. With proper supervision and quarantine it undoubtedly could have been limited to the Pacific Coast indefinitely. A quite unimportant importation of stock from California by a prominent Missouri nurseryman in the early 'nineties established this scale in several eastern nurseries, and this led to the first concerted effort to obtain a national quarantine and inspection law. The failure to reach an agreement among the nurserymen, fruit-growers, and entomologists as to suitable legislation prevented anything coming from this effort, although several Bills were introduced in Congress from time to time. In the meantime, the San José scale became so widely distributed by transportation on nursery stock that quarantine against this insect was no longer practicable; and the United States is now being taxed, and probably will be for all time, many million dollars annually because there was no law under which strong hold could have been taken of this danger at the outset.

As elsewhere noted, the recent effort to secure legislation followed the entry and wide distribution in the United States of brown-tail moth nests on nursery stock, chiefly from northern France. The discovery about the same time of the entry of the potato wart disease from Newfoundland, and the white-pine blister rust, chiefly from one district in Germany, greatly emphasised the immediate need for Federal control.

In the measure now before Congress, inspection of imported nursery stock is left to the different States instead of being undertaken by the Federal Government. A complete system of notification is provided for, however, both through the requirement of a permit and by subsequent advices to be given by the customs offices, the broker or first receiver of the stock, and the common carrier transporting it.

The first clause of the Bill is as follows:—It shall be unlawful for any person, firm, or corporation to import or offer for entry into the United States from any foreign country any nursery stock unless and until a permit shall have been issued therefor by the Secretary of Agriculture, under such conditions and regulations as the said secretary may prescribe, and unless such nursery stock shall be accompanied by a certificate of inspection in manner and form as required by the Secretary of Agriculture from the proper official of the country from which the importation is made to the effect that the stock has been inspected and found free from injurious plant diseases and insect pests: *Provided*, That this section shall not be construed as applying to plants or plant products solely intended for and adapted to use as food, but to nursery stock or other plants or plant products for propagation: *Provided further*, That nursery stock may be imported for experimental or scientific purposes, without the certificate of inspection or the permit of the Secretary of Agriculture hereinbefore required, upon such conditions and under such regulations as the Secretary of Agriculture may prescribe: *And provided further*, That nursery stock imported from countries where no official system of inspection for such stock is maintained, may be admitted upon such conditions and under such regulations as the Secretary of Agriculture may prescribe.

One clause in the Bill makes provision for quarantining foreign districts or particular plant products in foreign districts to exclude diseases or insect enemies which cannot otherwise be kept out. This is the provision which has been most objected to by importing nurserymen, and especially by importers who have invested in foreign nursery enterprises in France. It is not the intention to apply this section except in the case of diseases or other dangers which cannot be kept out by inspection or disinfection; in other words, at present it would apply only, so far as is known, to the potato wart disease and the white-pine blister rust. Another clause provides for quarantining districts within the United States where new diseases or insect enemies have gained a foothold until such districts have been freed from such disease or insects.

PRACTICAL STANDARDS FOR ELECTRICAL MEASUREMENT.[1]

THE committee has to regret the death since the last meeting of the association of Dr. G. Johnstone Stoney, F.R.S. He had been a member since 1861, and up to a few years since continued his active interest in the work. In its earlier stages his skill in definition and his admirable choice of nomenclature had proved invaluable to the committee. The collected reports which are to be issued shortly will indicate how large a share in the establishment of the C.G.S. system of units is due to him.

Republication of Reports.—The republication of the reports is not yet completed, but this should be done within the present year. The proofs of the reports from 1862 to 1883 have been finally revised, and the remaining proofs will soon be ready.

Lorenz Apparatus.—The progress made has been satisfactory. Preliminary experiments have shown that the apparatus is uninfluenced by changes in the earth's magnetic field, and that the thermal E.M.F.s at the brushes on the two discs very nearly balance. With the form of brush in use at present there are sudden changes in the difference of the thermal E.M.F.s amounting to 2×10^{-7} volt, and it may be difficult entirely to eliminate these. With other forms of brushes, *e.g.* those made of gauze, the difference was often 1000 times as great. It was this difficulty which led Lord Rayleigh in 1883 to amalgamate the edge of the disc, and as a further improvement Prof. Viriamu Jones and Prof. Ayrton used mercury jets instead of brushes. Since in the present apparatus the changes are only 1 in 10,000 of the difference of potential produced in one arrangement of the brushes and fewer for a second arrangement, it is hoped that mercury contacts will not be necessary. Further experiments will be made in order to obtain greater perfection, if such is possible.

Resistance Standards.—The construction of new mercury standards of resistance in accordance with the specification of the London Conference is being proceeded with, and some of the standards will be completed this year. Similar work is in progress in France, in Germany, in Austria, and in the United States. In the last-named country four standards have had all their constants determined, and the resistance unit so obtained is in very close agreement with that obtained from the old National Physical Laboratory standards.

In the committee's report for 1908 it was shown that many manganin resistance coils—some of which were purchased by the committee in 1895—were very changeable in resistance, and in consequence frequent comparison with mercury standards was necessary. In 1908 it was shown at the Bureau of Standards, and confirmed at the National Physical Laboratory and at the Reichsanstalt, that these changes were largely due to the effect of moisture on the shellac covering the wire. To eliminate this source of trouble many of the coils were hermetically sealed in 1909,

[1] Report presented at the Portsmouth meeting of the British Association by the Committee on Experiments for Improving the Construction of Practical Standards for Electrical Measurements.—Lord Rayleigh (chairman), Dr. R. T. Glazebrook (secretary).

and it is satisfactory to record that they are now much more constant. The importance of this hermetical sealing is so great when manganin resistances are to be sent to such places as cable stations in the tropics that the attention of instrument manufacturers is directed to the matter. Standard coils are readily sealed, and boxes of coils may be sealed in metal cases. The following figures for standard coils of manganin show the advantage of hermetical sealing :—

Nominal value		100 ohms		1,000 ohms	10,000 ohms
		No. 2450	No 740	No. 2449	No. 2448
Open coils	Oct. 1903	99·9959	1,000·153	1,000·012	10,000·24
	,, 1904	100·0002	0·172	0·244	2·40
	,, 1905	0·0048	0·218	0·494	3·57
	,, 1906	0·0092	0·248	0·668	3·82
	,, 1907	0·0132	0·266	0·814	3·74
	,, 1908	0·0288	0·302	1·130	3·85
Hermetically sealed in paraffin oil.	June 1909	0·0369	0·365	1·046	5·53
	,, 1910	0·0384	0·357	1·075	5·55
	,, 1911	0·0399	0·359	1·069	5·61

It will be noted that the changes during the last three years are very small.

Silver Voltameter and Standard Cell.—Although the actions which take place when a current passes through a solution of silver nitrate, as in a silver voltameter, are now well understood, the effects of septa—such as silk, filter paper, and porous porcelain—are by no means clear, and experiments have, therefore, been made to decide whether any septum at all should be used in a voltameter. Such experiments were suggested at the Washington meeting in 1910. The results of the experiments made at the National Physical Laboratory indicate that a septum of any kind is usually a source of trouble, and may produce secondary reactions during the electrolysis which affect the weight of the silver deposit. Fortunately, voltameters have been designed which render a septum unnecessary; and these may be useful, not only in precise current measurements with the silver voltameter, but for the deposition of metals other than silver.

The reproducibility and constancy of the Western normal cell are still being carefully examined. The chief anomaly is the hysteresis effect mentioned in last year's report; for this effect we have no explanation, although one is much needed, as probably it would enable cells to be made so as to remain even more constant in E.M.F. than at present. It is necessary to point out that while the effect is called a hysteresis one, the E.M.F. does not lag behind the temperature. Briefly put, with ascending temperatures the E.M.F. changes in close agreement with the temperature–E.M.F. formula, but with descending temperatures the E.M.F. changes too rapidly, corresponding to values at temperatures lower than the temperature of the cell by from 3° to 15°.

The committee had hoped to make this the last report; but in view of the fact that the republication is not complete, it asks for reappointment, with Lord Rayleigh as chairman and Dr. R. T. Glazebrook as secretary.

THE LOCH LEVEN WATER-POWER WORKS.[1]

THE Loch Leven Water-power Acts were obtained in 1901 and 1904, authorising the construction of works to utilise the rainfall of the western slope of Rannoch Moor for power for industrial purposes.

The catchment-area for the Loch Leven works is the basin of the River Blackwater, and is 55 square miles in extent, lying between Lochs Treig, Ossian and Rannoch, and Glen Coe. Rain-gauges established in 1905 and 1906 have given average readings of more than 70 inches for the Blackwater basin and 80 inches for Kinlochleven. No compensation-water had to be supplied, this feature greatly increasing the available power. The site of the reservoir is favourably contoured for storage purposes, and the full reservoir is about 7½ miles in length and half a mile in breadth. Its greatest depth is 75 feet, and it impounds more than 20,000 million gallons of water. The Blackwater dam is 3112 feet in length, with a maximum height of 86 feet, its top surface being 1068 feet above Ordnance datum. About half its length is formed as a waste-weir in six horizontal steps of 6 inches each.

The foundation is of an exceptionally sound character; only a few feet of the surface beds had to be removed to obtain a satisfactory foundation. The dam is built of large blocks of stone embedded in a matrix of ordinary concrete, with fine concrete facework. The valve-tower contains the six valves of the three draw-off pipes, the spindles being carried up to the valve-house above top water-level. The draw-off pipes lead to the upper penstock chamber, whence the water is delivered over a measuring weir into the conduit. Water is conveyed to the pipe-track by this conduit, which is 3½ miles in length; it is of square section, 8 feet by 8 feet, and is laid to a general gradient of 1 in 1000.

Along the route of the conduit and above the same lies a catchment-area of 3½ square miles, with a rainfall of about 75 inches, the greater part of which is drained by three streams. These have been laid under contribution by collecting their water and turning it into the conduit. Electrical transmitters and recorders indicate to the valve-keepers at the lower penstock chamber the changes taking place in the contribution of the side streams, enabling them to take advantage of the extra water and reduce the draw-off from the reservoir, thus storing an equivalent quantity of water in the reservoir. The conduit discharges its water into the lower penstock chamber, of about 300,000 gallons capacity, where it is measured and delivered to the pipes as required.

From the penstock chamber water is conveyed to the power-house in six welded steel pipes of 39 inches diameter. The track is 1¼ miles in length, and the fall of 935 feet yields a normal static pressure of 406 lb. per square inch. Water is distributed from the six main pipes to the various turbines by a system of pipes comprising two omnibus pipes and six feeders, all of 39 inches diameter. Each "bus" pipe with its three feeders forms one complete system, the two systems being at different levels to enable branches to cross. One branch from each bus pipe feeds each turbine. At the top of the pipe-track, immediately below the penstock chamber, automatic cut-off valves have been installed to stop the flow of water in the event of a burst occurring on the main pipe-lines.

The works described have cost about 600,000*l.*, and are now the property of the British Aluminium Company. The construction was begun in August, 1905, and the factory commenced working in February, 1909.

As regards the plant erected in the power-house at Kinlochleven, the aggregate power installed is 30,660 horse-power at the generator couplings, the generators being capable of a maximum output of 21,088 kilowatts. Nine main units and two exciter units are erected, each unit consisting of a turbine and two generators. The main turbines are of the Pelton-wheel type, with two water-jets, and are designed to give 3200 B.H.P. as a maximum; each drives two generators coupled in parallel, and having an output up to 2200 kilowatts together. The two small exciter units are also of the Pelton-wheel type, each driving a pair of generators on one shaft. These consist of an exciter and lighting machine, capable of giving an output up to 550 kilowatts, and a traction machine up to 94 kilowatts capacity.

Efficiency and governor tests were carried out on the main units, and governor tests on the exciter units. The results obtained showed that the turbines did not quite reach their anticipated output, and that their efficiency was slightly below that guaranteed by the makers. The efficiency was improved about 2 per cent. by increasing the area of the lower jet, but keeping the top jet of the original size, and by this alteration the turbines were enabled to give the specified output at the guaranteed efficiency.

It was found during the tests that the generators were liable to flash over if the voltage increased excessively, and

[1] From abstracts of two papers: (1) The Loch Leven Water-power Works, by A. H. Roberts; and (2) The Hydro-electric Plant in the British Aluminium Company's Factory at Kinlochleven, by F. B. Sonnenschein, read at the meeting of the Institution of Civil Engineers on November 14.

that they were also liable to flash over if a circulating current flowed round the two armatures of the dynamos on the same shaft running in parallel, when load was thrown off. An electrical protective device was therefore designed and fitted to each pair of generators, which automatically breaks the field-circuit when either of these two conditions arises.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The opponents of the statute allowing exemption from Greek in the case of candidates for honours in mathematics and natural science, which is to be submitted to Convocation on November 28, have put out a circular in which their objections are stated. One of their principal contentions is that when Greek becomes optional at the universities, the teaching of that language will be given up at many of the smaller schools throughout the country, and that in consequence many boys who are capable of profiting by the study will be deprived of the opportunity of instruction in Greek during their school career. The authors of the document say that while deprecating the abolition of compulsory Greek, they are favourable to a reform in existing methods of teaching and examination.

PROF. JOHN PERRY, F.R.S., will deliver an address at the opening of the new mechanical engineering laboratory of the Municipal Technical Institute, Belfast, on Friday, November 24.

MR. S. MANGHAM, formerly Frank Smart student in botany at Cambridge, has been appointed lecturer in botany at Armstrong College (University of Durham). Lord Grey has accepted the office of president of the college.

SUBSCRIPTIONS for 30,000*l.* to meet the conditional pledge of 10,000*l.* from the General Education Board have been received by Middlebury College. It is stated in *Science* that one-half of the fund will be reserved for general endowment.

AT the Sir John Cass Technical Institute, Aldgate, E.C., on Wednesday, November 29, Mr. H. Livingstone Sulman, president of the Institution of Mining and Metallurgy, will distribute the prizes and certificates gained by students during the past session.

THE Ontario correspondent of *The Times* announced on November 19 that the first day's subscriptions from Montreal to the million-dollar fund for McGill University reached 66,735*l.*, including 10,000*l.* telegraphed from London by Dr. James Douglas, who was formerly professor of chemistry at Morrin College, Quebec.

THE fourth annual dinner of old students of the Royal College of Science, London, is to be held at the Imperial College Union, Prince Consort Road, South Kensington, on December 13, at 7.30 p.m. The sixth annual dinner of the Finsbury Technical College Old Students' Association is to be held at the Trocadero Restaurant on December 9, at 7.30 p.m.

MRS. C. KAYLER has given 1000*l.* to University College Hospital to found and endow a lectureship in memory of her father, the late Dr. Sydney Ringer, F.R.S., formerly consulting physician to the hospital. The lecturer will be selected every two years, and will take as the basis of his lecture original research carried out by him in the physiological or pharmacological laboratories of University College or in University College Hospital Medical School.

THE death of Lady Reichel, which occurred at Bangor the next day after the degree ceremony noted in last week's NATURE, will be felt as a loss by all those interested in higher education in Wales. As wife of the principal of the University College of North Wales, Lady Reichel, while holding no important official position, had by her personality and influence rendered indirect services, of the value of which it would be difficult to form an adequate estimate, to the cause of education.

THE Board of Agriculture and Fisheries has awarded the following research scholarships in agricultural science:—P. G. Bailey (Cambridge), J. Clayton (Cambridge), J. T. Edwards, E. T. Halnan (Cambridge), J. Hammond (Cambridge), J. A. Hanley, G. E. Johnson (Birmingham), C. G. P. Laidlaw (Cambridge), A. E. Lechmere (Bristol), J. W. Lesley (Cambridge), A. Neville (London), and G. H. Spinks (Cambridge). These scholarships have been established in connection with the scheme for the promotion of scientific research in agriculture, for the purposes of which the Treasury has sanctioned a grant to the Board from the development fund. The scholarships, which are of the annual value of 150*l.*, and are tenable for three years, have been established in order to train promising students, under suitable supervision, with a view to their contributing to the development of agriculture, either by carrying out independent research or by acting in an advisory capacity to agriculturists.

AT the annual meeting of the Mathematical Association, to be held in January next, the following papers will be presented:—What should be omitted in arithmetic? J. B. Sachs; mathematical work in training colleges, Rev. E. M. Radford; some unrealised possibilities in mathematical education, G. St. L. Carson; the work of the International Commission on mathematical teaching, C. Godfrey; the calculus as a school subject, C. V. Durell. In addition the following subjects for discussion are proposed:—A recognised universal sequence of propositions in geometry for schools, H. G. Mayo; the educational value of the mathematics examination, E. F. Edwards; the logic of algebra, whether or where we should teach it, S. Andrade; the treatment of parallel lines, Rev. J. J. Milne; differentiation and integration as purely algebraic processes, W. F. Sheppard; is the educational prestige of mathematics lessening? G. St. L. Carson; the elementary teaching of the calculus, Rev. E. M. Radford; first lessons in algebra, W. A. Richardson.

IN connection with the work of the General Education Board of the United States, we learn from *Science* that conditional appropriations amounting to 127,000*l.* have been granted to six colleges and universities by the board of trustees. Applications from twenty-four institutions were presented. From this list the board selected six, among which is distributed conditionally the available funds as follows:—to Bucknell University, Lewisburg, Pa., 7000*l.* towards 32,000*l.*; to Earlham College, Richmond, Ind., 15,000*l.* towards 80,000*l.*; to Furman University, Greenville, S.C., 5000*l.* towards 20,000*l.*; to Grinnell College, Grinnell, Ia., 20,000*l.* towards 100,000*l.*; to Smith College, 40,000*l.* towards 200,000*l.*; to Southern Methodist University, Dallas, Tex., 40,000*l.* towards 200,000*l.* During the meeting attention was directed to the fact that since Mr. Rockefeller made his first contribution to the board for the promotion of higher education, contributions have been made to ninety-one institutions, amounting to 1,525,000*l.*, towards a total of 7,182,000*l.* Fifty-one institutions to which the board has made conditional contributions have completed the subscriptions for the supplemental sums required, and to these institutions the board has already paid 700,000*l.* in cash. As a result of the campaigns made by these fifty-one institutions, their assets have been increased by more than 3,800,000*l.* Their student bodies have increased by 2047, 183 new professors have been employed, and the annual payment to professors in these fifty-one institutions has been increased 84,300*l.*

As indicative of the growing appreciation of the value of higher education in science and technology among the native aristocracy of India, the following remarks, recorded in *The Pioneer Mail*, from a speech at an educational conference by the Nawab Bahadur of Dacca are interesting. Supporting the statement that "the want of a combined course of education has to answer for the degraded state of our community," he said:—"It is none the less due also to our utter indifference to technical, industrial, agricultural, and commercial education. If we had developed our industrial resources, improved our agriculture, and learnt business, hunger would not have peeped in our peasants' houses. Our interests would not have clashed had we not flocked to the general line of education only, but turned to other branches for which we might have special aptitude and be better fitted. The inevitable consequences of this wanton neglect of these branches have been the cramming of all offices and pro-

essions, and the poverty of the people. Our trades and ndustries are dying out, and prosperity is out of the ques- ion if we do not revive them. Our lands are immense reasures, for gold is buried there if we only render them roductive. We cannot grow one quarter of what they o in the civilised countries of Europe and America for the ame area. There is immense room for improvement in ll these directions, especially in agriculture; and although here has been a general awakening, and Government has een kindly lending its help, our capitalists do not come orward to invest money in such undertakings." He con- luded:—"I would most earnestly appeal to you to try o create an indomitable passion for education in your iends, relatives, and fellow-brethren, without which our ociferation for the regeneration of our community is but rying in the wilderness."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 16.—Sir Archibald Geikie, .C.B., president, in the chair.—Sir E. Ray **Lankester**: he discovery of a novel type of flint implements below e base of the Reg Crag of Suffolk, &c. (1) Flint imple- ents of human manufacture have been discovered by Mr. . Reid Moir, of Ipswich, in the detritus beds at the base f the Red Crag in Suffolk, and by Mr. W. G. Clarke at e base of the Norwich Crag in Norfolk. (2) These nplements are of a novel type—the "rostro-carinate," or eagle's beak"—but include also scrapers, hammers, and rge one-sided picks. They do not include any forms re- embling the Chellian and Acheuilian ovate implements. he sub-crag type (rostro-carinate) is essentially com- ressed from side to side. The Chellian and Acheuilian nd Moustierian types are essentially depressed or flattened ke a leaf. (3) They were manufactured at a period revious to one of severe glaciation, which set in before e lowest beds of the Red Crag and Norwich Crag were eposited, and characterise a phase of human development arlier than any hitherto known by equally indisputable idence. (4) The rostro-carinate implements were not nprobably used for dressing and smoothing the skins of nimals. (5) On the land surface from parts of which ese implements were moved into the detritus beds at the ase of the East Anglian "Crags," similar implements re- ained, which were embedded in the subsequent deposits the Glacial period, and have been found in a few isolated stances in mid-glacial sands and Boulder Clay. (6) The ed Crag is commonly regarded as of greater geologic e than its proper fauna would indicate. Its mammalian ssils are derivatives of an earlier age, and the few olluscs of Pliocene character found in its earlier layers e lingering survivors from a warmer condition of the a. They became extinct at the early onset of the con- tions proper to the Red Crag sea. The Red Crag should grouped with the Pleistocene rather than with the liocene series. (7) The race of men who manufactured e sub-crag flint implements probably lived on the land rface not remote from the sea during the period of the oralline Crag, which was characterised by a warmer imate than that of the Red Crag, and may justly be re- rded as marking the close of Pliocene conditions in this rt of Europe. The land barrier joining Britain to andinavia, which had kept the southern part of what now the North Sea from access of cold northern waters er since the earliest Tertiary period, disappeared at the ginning of the deposition of the Red Crag. (8) If these opositions are justified, it remains a question for later quiry whether the men who made the sub-crag imple- ents were of greater antiquity than those who made the plements (so-called eoliths) of the high plateau gravels Kent, or than those recognised by some archæologists makers of roughly chipped flints found in other locali- s, but not hitherto generally admitted as of human orkmanship. (9) In any case, the implements from the b-crag beds in East Anglia are of special and very tinct type, and cannot be associated with any known om any other locality.—Prof. E. W. **MacBride**: Studies heredity. I.—The effects of crossing the sea-urchins *hinus esculentus* and *Echinocardium cordatum*. Many ologists have investigated the question as to how far paternal and maternal characters are transmitted when different species of echinoderms are crossed, and have arrived at inconclusive and contradictory results. The reasons for the unsatisfactory results of their investigation are largely to be found in incomplete study of the normal development of the species to be crossed, and consequent dependence being placed upon characters which are either slightly marked or variable in the normal larva. There are two cases where the larvæ are distinguishable from one another by sharply marked characters, about the presence or absence of which there can be no possible doubt. The first case, that of the late larvæ of *Echinus miliaris* and *E. esculentus*, which are distinguished by the number of ciliated epaulettes, has been investigated by De Morgan and Shearer, who find that the hybrid in all cases shows purely maternal characters. The second case, that of the larvæ of *Echinus esculentus* and *Echinocardium cordatum*, the larvæ of which are distinguished by the presence of an aboral spike in those of the latter species and its absence in those of the former, forms the subject of this paper. It is shown that the eggs of Echinocardium fertilised by the sperm of Echinus give rise to hybrids which show the paternal character in the total absence of the spike, whilst the eggs of Echinus fertilised by the sperm of Echinocardium form a fertilisation membrane, but then undergo cytolysis. Loeb and his pupils have been able to fertilise the egg of sea-urchins with the sperm of animals belonging to different classes of animals. In all these cases the larvæ are a purely maternal type. It is, therefore, startling to find that when the eggs of Echino- cardium are fertilised with the sperm of a creature so far apart in systematic position as Echinus the paternal character should be so clearly marked in the hybrid.—Prof. W. M. **Thornton**: The influence of ionised air on bacteria.—Dr. T. Graham **Brown**: The intrinsic factors in the act of progression in the mammal. (1) By means of a stimulus (namely, section of the spinal cord) central in application, although remote from the local centre, the act of progression may be induced in muscles de-afferented by the cutting of their appropriate posterior spinal roots. It occurs thus after all the muscles of both hind limbs have been de-afferented, and all but the recording pair have been put out of action by motor paralysis. (2) The act of progression as exhibited by these muscles, and thus induced, scarcely differs, if indeed it differs at all, from the act similarly induced when the afferent parts of the recording muscles have not been broken. (3) In either case the reaction, as evidenced in movement at the ankle- joint, shows three periods. In the first the record is characterised by a state chiefly of maintained flexion. In the last there is a state characterised by maintained extension. Intermediate between these there is a period of "balance," in which the movements of progression are most perfect. (4) *The rhythmic sequence of the act of progression is consequently determined by phasic changes innate in the local centres, and these phases are not essentially caused by peripheral stimuli.* (5) *The proprio- ceptive stimuli which are generated by the contraction of muscles taking part in the act (when the appropriate posterior spinal roots are intact) play a regulating, and not an intrinsic, part in the act. Their chief importance may be in the grading of the individual component move- ments to the temporary exigencies of the environment.*— Dr. J. L. **Jona**: The refractive indices of the eye media of some Australian animals.—S. G. **Paine**: The permea- bility of the yeast cell.—G. A. **Buckmaster** and J. A. **Gardner**: Ventilation of the lung in chloroform narcosis. The authors give a number of plethysmographic tracings to show the lung-ventilation during chloroform anæsthesia with different percentages of chloroform and ether, and also analyses of the blood gases. They show that with un- impeded respiration under anæsthesia by chloroform given at a slight positive pressure the ventilation of the lung takes place at a lowered level. During a narcosis in which respiration continues the lung-ventilation is diminished in the first three minutes by about 60 per cent. of its original value, and by a similar amount after prolonged anæsthesia. They consider that the carbon-dioxide content of the blood is reduced below a threshhold value by any state of hyper- pnœa prior to administration of the drug, and this diminu- tion in carbon-dioxide content *plus* the diminished excita-

bility of the respiratory centre would suffice to slow or abolish the activity of the centre. Gas analyses actually show that with a deep and rapid respiration there is a marked fall in the carbon-dioxide content of the blood. They also bring forward evidence to show that the diminution in oxygen content of the blood during chloroform narcosis is not due entirely to diminished alveolar ventilation, but to the action of the drug on the red corpuscles. —Lord **Berkeley** and M. P. **Appleby**: (1) The boiling point of water; and (2) the boiling points of some saturated aqueous solutions.—Dr. R. T. **Glazebrook**, W. R. **Bousfield**, and F. E. **Smith**: The heating effect of the currents in precise measurements of electrical resistance.

Linnean Society, November 2.—Dr. D. H. Scott, F.R.S. president, in the chair.—Dr. D. H. **Scott**: The Palæozoic fern *Zygopteris Grayi* (Williamson). The group of comparatively simple ferns (Primofilices of Arber, Cœnopteridæ of Seward) to which this plant belongs is chiefly known by petrified specimens showing structure. Correlation with impressions showing the habit has seldom been possible; fronds, however, belonging to a Zygopteris have been identified. *Z. Grayi*, a species founded by Williamson in 1888, is a rare fossil. A new specimen, from Shore Littleborough, in Lancashire, was found by Mr. Lomax last year, and series of transverse and longitudinal sections were prepared. The question whether this species belongs to Ankyropteris or Etapteris, as these genera are defined by Paul Bertrand, has been disputed. The new specimen is certainly an Ankyropteris, as shown by the presence of "peripheral loops" of small-celled xylem on the leaf-trace. Thus the view of Paul Bertrand is confirmed; it appears to hold good for all known specimens of *Z. Grayi*. *Zygopteris*, or, as we may now call it, *Ankyropteris Grayi*, is a highly developed member of the Primofilices, and presents interesting analogies with the curious genus Asterochlæna, recently described in full detail by Paul Bertrand. —Miss Edith E. **Bamford**: Pelagic actinian larvæ. The author stated that the collection of actinian larvæ from the Indian Ocean consists of thirteen different types, the chief interest lying in the four zoanthidean larvæ, all being new species of the genus Zoanthina, Van Beneden, represented by single specimens.—A. O. **Walker**: The distribution of *Elodea canadensis*, Michx., in the British Isles in 1909. *E. canadensis*, Michx., is said to have been first seen in Ireland in 1836 and in Berwickshire in 1845. By 1850 it had become so abundant in many parts of the British Isles as to be a serious nuisance by choking up canals, watercourses, and drains, and all attempts to clear it out failed. It was found, however, that after a few years it died out, or became comparatively scarce and feeble. Information on the subject is given in the paper from twenty-four counties in England and Wales, six in Scotland, and three in Ireland, showing, on the whole, that the plant has decreased of late.—Dr. J. **Murie**: The "slipper limpet" (*Crepidula fornicata*). It was pointed out that the "limpets" have now become a nuisance on the oyster-beds of both Kent and Essex. Originally they were imported from America, coming among the barrelled oysters brought over for relaying. They have since become thoroughly naturalised, and on the Blackwater and River Crouch are dredged up in tons attached to the oysters, mussels, &c. Unlike the starfish, devourers and arch-enemies of the oyster, or the mussels, which smother them, and the whelk tingles, which bore through their shells, the "slipper limpet" is more of a commensal parasite and messmate, partaking of the oyster's food. But what now chiefly renders them a serious menace to oyster-culture is the labour and expense involved in constant dredging for them, as likewise the necessity for individually chopping them off by "cultack" before the oysters are presentable for sale or replanting.

Zoological Society, November 7—Mr. Frederick Gillett, vice-president, in the chair.—T. E. **Gunn**: The presence of two ovaries in certain British birds, more especially the Falconidæ. The author outlined the views held by the majority of English morphologists on the reproductive organs of adult female birds, and enumerated examples which he had collected during a number of years where the right as well as the left ovary was present, and, so far as could be ascertained, in the two cases of which sections had been made, where the right ovary was functional. He pointed out the extraordinary preponderance in his examples of paired ovaries occurring in the Falconidæ, as compared with those derived from any other source, and remarked that in that family the ovaries were usually placed symmetrically one on either side of the vertebral column and at about the same level. In examples other than the Falconidæ this symmetrical arrangement was the exception rather than the rule, the right ovary generally occupying a position almost directly below the left, in the left half of the body-cavity, which, in the author's opinion, suggests a half-way home on the road leading to the final disappearance of the right ovary.—D. **Seth-Smith**: The moulting of the King penguin (*Aptenodytes pennanti*) in the society's Gardens. The author referred to Mr. de Winton's paper on the same subject which appeared in the Proceedings in 1898. The specimen observed by Mr. de Winton did not moult until it had lived sixteen months in the Gardens, whereas the specimen now in the menagerie had moulted twice in six months. The author stated that the new feathers were almost fully grown before the old ones were shed, and that the latter had to be rubbed off by the bird's beak or feet, as they were firmly attached to the sheaths of the new feathers. The paper was illustrated by photographs, which showed the bird in various stages of the moult, as well as by specimens of the shed feathers.—Prof. A. D. **Imms**: Some Collembola from India, Burma, and Ceylon, with a catalogue of the Oriental species of the order. Four genera and twenty-eight species were described as new, amongst the latter the most remarkable being a form unique among Collembola in possessing a median cercus to the fifth abdominal segment, and for the reception of which a new subfamily was formed. The total number of Collembola known from the Oriental region was stated to amount to fifty-three species comprised within twenty-seven genera.—Prof. P. P. **Sushkin**: Ontogenetical transformations of the bill in *Ardea cinerea*. The author gave a description of the gradual development of the bill in a series of embryos and young specimens of the heron upon which he had made observations. The simple rhamphotheca proved to be only a late stage of the compound one, and the form of the Ardeine bill he regarded as a derivative one, and discussed its resemblance to those of allied forms.

MANCHESTER.

Literary and Philosophical Society, October 31.—Prof. F. E. Weiss, president, in the chair.—Thomas **Thorp**: A new method for testing the curvature of parabolic mirrors. The method consists in tilting the mirror with a delicate tangent screw so that each portion of the mirror is successively brought into a horizontal position. —Miss P. C. **Esdaile**: A study of the scales of the salmon. It was shown that no two scales of the many scores examined from different parts of the one fish had the same number of lines, though they all had the same number of *annual* markings. Research during the past year indicated that the number of lines in each annual group increases gradually on scales taken from near the head to those taken near the fleshy (adipose) fin; and then from this position to the tail there is a decrease in the number of lines in each annual group. Also, the scales on the upper side of the body have fewer lines than those on the lower side. Thus the scales are not all of the same size, increasing in length and breadth as the number of lines increases. Near the adipose fin, the part of the fish with nearly the smallest girth, the scales are, so far as known, the longest and broadest, and have the greatest number of lines. The results clearly indicate that as yet it would be premature to state how many lines are formed during each year or each month.

November 14.—L. V. **Meadowcroft**: A geometrical treatment of geodesic torsion.—Dr. A. A. **Mumford**: Observations on some factors which have caused the improved physique of boys at the Manchester Grammar School during the last thirty years. In comparing the differences in height, weight, and physical development generally of the boys at the school during the period 1881–6 as compared with the period 1905–10, the author discussed the causes—better housing, improved diet, greater insight into the meaning of parental responsibility as regards health, &c.—to which he attributed the remarkable increase in height and weight of the boys. He referred to the changed attitude

towards athletics and physical culture, particularly during the earlier ages, prevailing to-day, and, further, directed attention to the fact that, from the statistics he put forward, it appeared that the later the onset of infectious diseases can be postponed beyond the earliest years of childhood, the better it would appear to be for the future growth and vigour of the child.

PARIS.

Academy of Sciences, November 13.—M. Armand Gautier in the chair.—J. **Violle**: A reversion of the double rose to the single form. A de Dijon rose, which for the last twelve years had borne large numbers of the usual double flower, possibly as a consequence of the dry and hot summer suddenly in September developed on all its branches single roses. These were followed eight days later by a crop of the usual double rose.—A. **Laveran** and D. **Roudsky**: Concerning the action of oxazine (triaminophenaxoxonium), chloride, and acridine (diphenylmethane) on trypanosomes. An account of experiments on the cause of the disappearance of the centrosomes from the trypanosome under the action of oxazine.—Pierre **Termier**: The tectonic in French Basque country.—J. Ph. **Lagrula** and H. **Chrétien**: The Brooks comet (1911*c*); its photographic appearance and its spectrum. The photograph showed a clearly defined globular nucleus with a tail formed of numerous filaments, nine of which were sufficiently well marked to measure their angles of position. The spectrum was photographed on a pinacyanol plate, recording from the ultra-violet to the red. It proved to be very similar to the spectrum of the Daniel comet taken with the same apparatus. The spectrum was continuous, with the cyanogen and carbon bands superposed.—A. **Demoulin**: The Ω surfaces.—L. **Schlesinger**: A differential system with fixed critical points.—G. **Kowalewski**: A property of the transformations of Volterra.—M. **Jouguet**: The acceleration of waves of shock in wires.—Jean **Becquerel**: The propagation of light in fluorescent bodies. Neither in the ruby nor the emerald does the state of fluorescence sensibly modify the velocity of propagation of the radiations of the same period as those emitted. Within the limits of accuracy of these experiments a fluorescence absorption does not appear to exist.—Kr. **Birkeland**: Celestial phenomena and experimental analogies. Photographs of further experiments made with a magnetic globe as kathode in a large Leyden jar. The examples given in the reproductions of the photographs include the imitations of Saturn's ring, of some nebulæ, and of the sun-spots.—Pierre **Weiss** and O. **Bloch**: The magnetisation of nickel, cobalt, and of alloys of nickel and cobalt. For those alloys for which magnetic saturation was possible, the Curie constant was found to be a linear function of the percentage composition of the alloys.—Chaspoul and Jaubert **de Beaujeu**: Researches on the radio-activity of the waters of Vals-les-Bains. No general relation appears to exist between the radio-activity of water and the mineral constituents. In the bicarbonate waters of Vals, however, the free carbonic acid varies in the same sense as the radio-activity.—Pierre **Girard** and Victor **Henri**: Concerning some new hypotheses on the molecular state of bodies in solution. The van 't Hoff-Arrhenius theory of solution has recently been criticised adversely by Colson and Fouard, the former on the basis of cryoscopic measurements, the latter from the results of osmometric experiments. The author shows reasons for supposing that in the experiments of Fouard the equilibrium observed was not that due to the true osmotic pressure, but was the result of osmotic currents of electrostatic origin. It is concluded that the facts brought forward by MM. Colson and Fouard cannot be regarded as controverting the theory of van 't Hoff and Arrhenius.—E. **Boismenu**: The hypoiodous amides. Details are given of the mode of preparation and properties of the iodine derivatives of acetamide, propionamide, and formamide. These all contain the group —NI, are decomposed by water, decolorise indigo, and liberate from a solution of potassium iodide twice the amount of iodine contained in the molecule. They are very unstable, and the stability decreases as the molecular weight is lower.—M. **Lespieau**: Some properties of monobromacrolein. Monobromacrolein gives pyrazol when treated with hydrazine hydrate; the aldehyde does not react with pure hydrocyanic acid, but a violent reaction is induced by the presence of a trace of potassium cyanide, the product being a nitrile alcohol giving the acid $CH_2:CBr.CH(OH).CO_2H$.—E. **Chablay**: Researches on the metallic alcoholates.—P. L. **Viguier**: Attempts at the direct preparation of tetrolic aldehyde. An account of unsuccessful attempts by three methods to prepare tetrolic aldehyde.—Marin **Molliard**: The action of various polyureides and of hippuric acid on the development and tuber formation of the radish. Tuber formation was found to be favoured by the presence of sodium urate.—C. **Picado**: The epiphyte Bromeliaceæ as a biological medium.—P. A. **Dangeard**: The sulphur bacteria.—M. **Radais** and A. **Sartory**: The toxic properties of the *Mapou* (*Agauria pyrifolia*). The leaves, flowers, fruit, and seeds of this plant contain a very toxic substance or substances soluble in water or weak alcohol. Boiling the solution does not destroy the toxicity. There are some indications that the toxic substance is a glucoside.—Paul **Godin**: Some conclusions from my researches on growth in man relating to puberty.—A. **Magnan**: A human acephalous monster.—Jacques **Pellegrin**: The aquatic vertebrates of the Sahara.—Louis **Semichon**: The heterogonic cycle of *Pterocallis tiliae* and the presence of chlorophyll.—D. **Keilin**: Certain constant sensitive organs in the larva of Diptera and their probable significance.—Henri **Agulhon**: The mechanism of the destruction of the diastases by light. Experiments with succase, laccase, and tyrosinase showed that these three diastases are not attacked by ordinary light in a vacuum. The ultra-violet rays from a quartz mercury vapour lamp partially destroys them, although not to so great an extent as when oxygen is present. The hypothesis that the actual agent destroying the diastases is hydrogen peroxide, formed by the action of the light, accords well with the experimental facts.—H. **Gaehlinger** and A. **Tilmant**: The caseifying action of certain lipoids.—Maurice **Lugeon**: Some consequences of the hypothesis of a dualism of the Palæozoic foldings in the western Alps.—G. **Le Cadet**: The origin of the electrical manifestations of storms, on the occasion of the observation of cyclones in China seas. In the vertical terrestrial electric field a vortex with horizontal axis can develop influence charges and sufficient differences of potential to cause disruptive discharges.—J. **Vallot**: The protection of observatories at high altitudes against lightning. In the two observatories on Mt. Blanc, one is surrounded by metal directly connected with the rock on which it stands by numerous metallic connections, and this has never been struck by lightning. The other, the Janssen Observatory, stands on snow, and connection has to be made with the earth by means of a cable 100 metres long. In spite of numerous alterations and additions to the protecting apparatus, this observatory has been repeatedly struck, and electrical phenomena have been observed inside the building, in some cases lasting for more than two hours, and resulting in personal injury to the occupants and fusion of various metal instruments and utensils. It is concluded that for buildings established on snow at a considerable distance from rock there is no means known of protecting against lightning.—M. de Montessus **de Ballore**: The distribution of seismic instability in Bolivia.

BOOKS RECEIVED.

Heroic Lives of the Nineteenth Century. By C. Scudamore. Pp. vii+351. (London: G. Routledge and Sons, Ltd.) 3*s*. 6*d*.

The Boy Fancier. By F. T. Barton. Pp. xx+435. (London: G. Routledge and Sons, Ltd.) 5*s*.

The King to his People: being the Speeches and Messages of his Majesty George V. as Prince and Sovereign. Pp. xviii+452. (London: Williams and Norgate.) 5*s*. net.

The Importance of the Jews for the Preservation and Revival of Learning during the Middle Ages. By Dr. M. J. Schleiden. Translated by M. Kleimenhagen. Pp. 63. (London: Siegle, Hill and Co.) 1*s*. 6*d*. net.

The Queen of the Castle. By A. Wilson. Pp. 144. (Ilkeston: H. Wilson and Co.) 6*d*. net.

The World's Minerals. By L. J. Spencer. Pp. xi+212+40 coloured plates. (London and Edinburgh: W. and R. Chambers, Ltd.) 5*s*.

The Mind of Primitive Man. By F. Boas. Pp. xi+294. (London: Macmillan and Co., Ltd.) 6s. 6d. net.

Unity in Nature: an Analogy between Music and Life. By C. E. Stromeyer. Pp. x+589. (London and Manchester: Sherratt and Hughes.) 12s. 6d. net.

Outlines of Education Courses in Manchester University. Pp. viii+189. (Manchester: University Press.) 3s. net.

A Text-book of Practical Chemistry for Technical Institutes. By Dr. A. E. Dunstan and F. B. Thole. Pp. x+335. (London: Methuen and Co., Ltd.) 3s. 6d.

Plant Life and Evolution. By Prof. D. H. Campbell. Pp. iv+360. (New York: H. Holt and Co.) 1.60 dollars net.

Ministère de l'Agriculture. Direction de l'Hydraulique et des Améliorations Agricoles. Service des Grandes Forces Hydrauliques (Région des Alpes). Compte Rendu et Résultats des Études et Travaux au 31 Décembre, 1910. Tome iv. Pp. 556. Annexe i. Cartes. Pp. 14+8 maps. Annexe ii. Nivellements. Thirty-three plates.

An Elementary Treatise on Cross-ratio Geometry, with Historical Notes. By the Rev. J. J. Milne. Pp. xxiii+288. (Cambridge: University Press.) 6s.

A Primer of Astronomy. By Sir R. S. Ball, F.R.S. Reissue. Pp. viii+228. (Cambridge: University Press.) 1s. 6d. net.

Chemie und Technik. By Dr. G. Bugge. (Bücher der Naturwissenschaft, li. Band.) Pp. 190. (Leipzig: P. Reclam, jun.)

The Sun. By C. G. Abbot. Pp. xxv+448. (London: D. Appleton and Co.) 7s. 6d. net.

The Process of the Year. Notes on the Succession of Plant and Animal Life. By H. H. Brown. Pp. 180. (London: S.P.C.K.) 2s. 6d.

An Intermediate Text-book of Botany. By E. Evans. Pp. viii+394. (London: Longmans and Co.) 6s.

Philosophy. By N. M. Butler. Pp. vii+51. (New York: Columbia University Press; London: Frowde.) 4s. 6d. net.

Charles Darwin and Samuel Butler. A Step towards Reconciliation. By H. F. Jones. Pp. 28. (London: Fifield.) 1s. net.

The Advance of Photography. Its History and Modern Applications. By A. E. Garrett. Pp. xiii+382. (London: Kegan Paul and Co., Ltd.) 12s. 6d. net.

A History of British Mammals. By G. E. H. Barrett-Hamilton. Part ix. Pp. 121–168. (London: Gurney and Jackson.) 2s. 6d. net.

A Text-book of the Principles of Physics. By Dr. A. Daniell. New and revised edition. Pp. xxv+819. (London: Macmillan and Co., Ltd.) 17s. net.

A Text-book of Physics. By Prof. L. B. Spinney. Pp. xi+605. (London: Macmillan and Co., Ltd.) 12s. net.

Ancient Hunters, and their Modern Representatives. By Prof. W. J. Sollas, F.R.S. Pp. xvi+416. (London: Macmillan and Co., Ltd.) 12s. net.

Selsey Bill: Historic and Prehistoric. By E. Heron-Allen. Pp. xvi+404+3 maps+lvii plates in text. (London: Duckworth and Co.) 2l. 2s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.30.—On the Iron Flame Spectrum and those of Sun-spots and Lower-type Stars: Sir N. Lockyer, K.C.B., F.R.S.—Sinhalese Iron and Steel of Ancient Origin: Sir R. A. Hadfield, F.R.S.—On the Conductivity of a Gas between Parallel Plate Electrodes when the Current approaches the Maximum Value: Prof. J. S. Townsend, F.R.S.—Spectroscopic Investigations in connection with the Active Modification of Nitrogen. II. Spectra of Elements and Compounds excited by the Nitrogen: Hon. R. J. Strutt, F.R.S., and Prof. A. Fowler, F.R.S.—The Less Refrangible Spectrum of Cyanogen, and its Occurrence in the Carbon Arc: Prof. A. Fowler, F.R.S., and H. Shaw.—Note on the Monatomicity of Neon, Krypton, and Xenon: Sir W. Ramsay, K.C.B., F.R.S.—The Adherence of Plain Surfaces: H. M. Budgett.—On the Resistance to the Motion of a Thread of Mercury in a Glass Tube: G. D. West.—The Distillation of Binary Mixtures of Metals in vacuo. Part I. Isolation of a Compound of Magnesium and Zinc: A. J. Berry.—Analysis of Tidal Records for Brisbane for the Year 1908: F. J. Selby.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Reversible Battery Boosters: R. Rankin.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Huxley Memorial Lecture.—The Early Inhabitants of Western Asia: Prof. F. von Luschan.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Development of the Copper Queen and the Warren Mining District: Dr. James Douglas.

CHEMICAL SOCIETY, at 8.30.—*Extra Meeting.*—Prof. Harold B. Dixon, F.R.S., will deliver the Berthelot Memorial Lecture.

FRIDAY, NOVEMBER 24.

PHYSICAL SOCIETY, at 5.—The Maximum Value of the Electric Stress between Two Unequal Spherical Electrodes: Dr. A. Russell.—The Cubical Expansion of Fused Silica: F. J. Harlow.—On the Temperature Coefficient of Diffusion: B. W. Clack.—The *a* Particles emitted by the Active Deposits of Thorium and Actinium: E. Marsden and T. Barratt—The Magnetic Transition Point of Cementite: S. W. J. Smith, W. White, and S. G. Barker.

SATURDAY, NOVEMBER 25.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—More about Dr. Benjamin Allen (1663–1738), of Braintree, and his Common-Place Book: Miller Christy.—A Bronze-age Pit-dwelling at Epping, Essex.—Notes on White Varieties of Flowers: C. Nicholson.

MONDAY, NOVEMBER 27.

ROYAL SOCIETY OF ARTS, at 8.—The Carbonisation of Coal: Prof. Vivian B. Lewes.

INSTITUTE OF ACTUARIES, at 5.—A New Method of approximating to the values of Last Survivor Annuities on two or more lives, and to the values of Joint Life Annuities when the advantages of Makeham's Law are not available: G. J. Lidstone.

TUESDAY, NOVEMBER 28.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Prehistoric Monuments in the Outer Hebrides and their Astronomical Significance: Capt. Boyle T. Somerville, R.N.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Lighting of Railway Trains: The Brake-Vehicle Method: R. T. Smith.

WEDNESDAY, NOVEMBER 29.

ROYAL SOCIETY OF ARTS, at 8.—The Efficiency of the Aëroplane: A. E. Berriman.

FRIDAY, DECEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Brake-lining Coefficients of Friction: J. and W. Legg.

CONTENTS.

THURSDAY, NOVEMBER 30, 1911.

THE SCIENTIFIC STUDY OF MAMMALS.

The Age of Mammals in Europe, Asia, and North America. By Prof. Henry Fairfield Osborn. Pp. xvii+635, with illustrations. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 18*s*. 6*d*. net.

DURING recent years no branch of study has made more important contributions to biology than that of extinct mammals. It has not only led to a more satisfactory understanding of the mammals themselves and their relationships. It has also thrown unexpected light on the general processes of organic evolution and the problems of geographical distribution. The broad features in the secular development of several groups of mammals are now better known than the growth stages in the individual life-history of many common existing species; and the underlying principles are often discoverable from a consideration of the numerous recurring phenomena which are sufficiently well known for comparison.

The literature of the subject, however, has become so voluminous and scattered that the time has arrived for an exhaustive critical summary. The aimless casual descriptions of so-called new species and varieties can only be superseded by real contributions to science when the present position of the various problems is clearly understood. Zoologists, especially palæontologists, are therefore much indebted to Prof. H. F. Osborn for the great labour he has bestowed on his new work, "The Age of Mammals," which furnishes the necessary summary by a master-hand and forms a sure basis for future research.

Prof. Osborn's volume is intended for general scientific readers as well as for specialists. It is thus prefaced by an interesting introductory section on the principles of palæontology as illustrated by extinct mammals, and on certain related geological questions. The treatment is more or less historical, with full references to the original authors, and there are several explanatory diagrams and maps. A table of strata (Fig. 13) marking the periods of successive earth-disturbances which gave rise to various mountain-systems, is especially striking. During the "Age of Mammals," or Tertiary period, the Pyrenees, Swiss Alps, and Himalayas have been formed in the Old World, while the Rocky Mountains have originated in North America.

It is well known that mammals first arose during the Secondary period, or "Age of Reptiles," but remained insignificant and restricted in their range until practically all the dominant reptiles had passed away. Prof. Osborn alludes more than once to this apparently sudden world-wide extinction of the dinosaurs, ichthyosaurs, plesiosaurs, and pterodactyls which flourished until the end of Cretaceous times; but it is only to emphasise the inexplicable nature of the phenomenon. As he remarks,

"Reptiles are so sensitive to temperature that it is natural to attribute this extinction to a general refrigeration, but the flora shows no evidence of this either in Europe or America; nor is there evidence of any great geographic cataclysm on the surface of the earth, for the plant-life transition from one age to the other in the Rocky Mountain region is altogether gradual and gentle."

Whatever may have been the cause, so soon as the great reptiles had disappeared, small primitive mammals of the kind which arose in the Secondary period suddenly began to multiply, and spread both in Europe and North America, perhaps also in South America. Their remains are found in the Basal Eocene deposits. None of these animals, however, appear to be directly ancestral to more modern groups, the direct forerunners of which arrived both in Europe and North America from some undetermined region in the period of the Lower Eocene. This second mysterious migration furnished the source of the lemurs, insectivores, true carnivores, rodents, and perissodactyl and artiodactyl ungulates. A few of the primitive mammals still survived with them through the Eocene until the beginning of Oligocene times, most of them grown unwieldy in size, such as the herbivorous Coryphodon and Uintatherium, or the carnivorous Mesonyx; but their brain remained small and simple, and they could not compete with the higher mammals in which advance in brain-power accompanied progressive elaborations in the limbs and dentition.

During the Oligocene period, sabre-toothed cats, dogs, martens, pigs, and rhinoceroses became recognisable, both in Europe and North America, while the viverrines occurred in Europe, and the hares and primitive camels were characteristic of North America. Africa was then a separate land-area, the scene of the early development of hyracoids and proboscideans. In all regions there were certain precocious and aberrant types, such as the titanotheres of North America and Arsinoitherium in Egypt, which only flourished for a short time, without leaving descendants. At the beginning of the Miocene period the most noteworthy event was the connection of Africa with Europe, which allowed the proboscideans to spread over the whole of the northern hemisphere, where they flourished and increased in size. There were now true cats and bears, tapirs, and rhinoceroses, both in the Old and New Worlds; while by the end of the Miocene the horses had nearly become one-toed, and apes, antelopes, okapis, and horned deer had appeared, at least in the Old World.

By the end of the Pliocene period mammals had become much as they are now, though most of the groups were more widely distributed, and they comprised many large species which soon disappeared after the advent of man. From the early Eocene until the early Pliocene, South America had been an isolated land-area, on which mammals had developed into several strange groups of ungulates and the true edentates (sloths, armadillos, and ant-eaters). Before the end of the Pliocene, the emergence of the isthmus of Panama permitted some of these types to wander north into the southern United States, while the camels (llamas and alpacas), cats, dogs, deer, pigs, horses, and mastodons were able for the first time to spread to the southern continent. At the end of the Pliocene period

there is evidence of extensive desiccation in western North America, southern South America, north-central Africa, and central Australia; and physical changes which are not yet understood led to a glacial epoch in the northern hemisphere in Pleistocene times. These phenomena had doubtless much to do with the extinction of the large quadrupeds and the impoverishment of the mammal fauna. Civilised man has continued the destruction.

The whole of this fascinating story is told in detail by Prof. Osborn, who not only discusses the mammals themselves, but also describes the rocks in which their remains occur, and briefly notices the successive changes in geography which they indicate. His work is illustrated by numerous text-figures of skeletons, restored sketches of extinct mammals made by the American Museum of Natural History, photographs of scenery, and diagrammatic geological sections. As might be supposed, much of it is extremely technical, and to be used for reference rather than systematic reading; but it is enlivened throughout by a succession of interesting generalisations, which are all the more valuable as having been either suggested or confirmed by the author's own researches. The peculiar feature of Prof. Osborn's book, indeed, is its stimulating freshness, and he is to be congratulated on the impulse which it is certain to give to the studies with which it deals. A. S. W.

GEOGRAPHICAL DISTRIBUTION OF FERNS.

Die Geographie der Farne. By H. Christ (Basel) Pp. 357+3 maps. (Jena: Gustav Fischer, 1910.) Price 12 marks.

DR. CHRIST has produced a volume of remarkable interest on the geographical distribution of ferns, which forms a worthy companion to Schimper's well-known "Pflanzen-Geographie auf physiologischen Grundlage." The book has been arranged in a somewhat similar manner to Schimper's "Plant Geography," and is divided into two parts. The first consists of 136 pages, devoted to considerations of the effects of soil, climate, &c., on the distribution of ferns, and in the second part the ferns of the different geographical areas are described in detail.

To the general botanist, and more particularly to the ecologist, the first portion of the book has the greater interest. Ferns, unlike the flowering plants, though very widely distributed, are not universally found over the surface of the earth, since they are definitely limited as to their environment by the need for water, and though many species are remarkable for their capability of resisting desiccation, yet they are unable to grow where the rainfall is below a certain amount. Being in the main shade plants, their maximum distribution tends to follow the wooded areas of the globe; and the dry desert areas are almost destitute of ferns.

Though mainly found growing on humus, some ferns are affected by the nature of the substratum, and this is especially the case with calcareous soils. It may often happen, however, that chalk-shunning ferns may be found on that formation owing to the depth of humus by which the calcareous soil is overlaid.

Striking examples of ferns which avoid the chalk are afforded by *Asplenium septentrionale* and by the world-wide *Pteridium aquilinum*—the bracken fern—which is found in both hemispheres, from "the equator to the poles." *Asplenium viride* and *Cystopteris montana*, on the other hand, may be cited as examples of species characteristic of the chalk. Halophytes, again, have their fern representatives, and *Acrostichum lomarioides* from the brackish swamps of tropical America, and *A. aureum*, which grows in the Rhizophora estuaries, are striking examples of this type of plant.

Then again there are the fresh-water swamp ferns, such as the widely distributed *Dryopteris thelypteris* and the well-known water fern, *Ceratopteris thalictrioides*.

The majority of ferns are perennial, but there are a few exceptions, of which Ceratopteris is one, and also the annual fern, *Anogramma leptophylla*.

Ferns afford parallels to Phanerogams in their choice of habitats and relations to climatic conditions, and also in their external forms they provide counterparts to other types of vegetation. We find them, for example, as epiphytes; tree ferns; scramblers or bramble ferns (Gleichenia, Odontosoria, &c.); twining ferns, such as *Blechnum volubile;* tendril climbers (*Lathyropteris madagascariensis*), and creeping epiphytes or rhizome climbers, which are well illustrated by the aroid-like *Oleandra neeriformis*.

The general biological features of hygrophytic ferns, hairs, secretions, storage organs, &c., are also described with a wealth of illustration.

An interesting section is devoted to the description of the xerophytic types, many of which have their home in the Andes, on the same lines as that for the hygrophytes. Two characteristic forms may be recognised: the Cheilanthes type, with short rhizome, deep roots, and small hairy pinnæ, and the Elaphoglossum type, where the rhizome is thick and creeping and the leaves tongue-like, leathery, and simple. The genera Cyclophorus, from the Old World, and Elaphoglossum, centred in the Andes, afford the most striking examples.

Ferns of high alpine or arctic regions are few, and, as compared with the phanerogamic vegetation of such situations, are not particularly characteristic. Cryptogramma and Woodsia, however, may be cited as typically northern alpine forms, while *Polystichum mohrioides* is a typical antarctic-andine species. One of the highest known species is another Polystichum, *P. Duthei*, from Kumaon, which occurs at an altitude of from 13,000 to 17,000 feet.

The bulk of the second part of the book is concerned with the fern flora of the different geographical regions, but it is preceded by some very interesting pages dealing with general questions of geographical distribution, such as the effect of the Ice age and the relics of the fern flora of past ages. The distribution of several genera is outlined, but space does not permit of a review of this section of the book in further detail. Attention may, however, be directed to the remarkable case of distribution afforded by

the genus Pleurosorus, which is found as three scarcely differing forms in Southern Spain (*P. Pozoi*), South Chile (*S. papaverifolius*), and Australia (*P. rutaefolius*). These small xerophytic rock ferns may well be cited as examples of the simultaneous appearance of a species in widely separated localities.

There is but one fault to find with this otherwise excellent book, and that is that the illustrations, most of which are very good, have been inserted without any particular reference to the text, and some difficulty is experienced in attempting to find the figures which are intended to illustrate particular descriptions.

A. W. H.

OPHTHALMIC THERAPEUTICS.

An International System of Ophthalmic Practice. Edited by Dr. Walter L. Pyle. Therapeutics. By Dr. A. Darier. Translated by S. Stephenson. Pp. xiv+444. (London: Rebman, Ltd., 1911.) Price 17*s.* 6*d.* net.

THIS is the first volume of an "International System of Ophthalmic Practice," edited by Dr. Walter L. Pyle, of Philadelphia. Other volumes announced are on "Medical Ophthalmology," by Dr. Arnold Knapp, of New York; "Ophthalmic Diagnosis," by Dr. Charles H. Beard, of Chicago; "Pathology and Bacteriology of the Eye," by Messrs. Treacher Collins and M. S. Mayou, of London; "Affections of the Orbit and Accessory Cavities," by Dr. Christian R. Holmes, of Cincinnati; "Examination and Refraction of the Eye and Eye-strain," by the editor; and "Ophthalmic Surgery," the authorship of which is not stated. It will be seen that the scheme is comprehensive, and that the aim is essentially practical. The authors are men of established reputation, and may be relied upon to carry out their work ably, so that the system will form a valuable, if not indispensable, addition to the ophthalmologist's library. If the volumes reach the standard of the sample which we have before us we may confidently prophesy the financial success of the series.

Those who have read Dr. Darier's lectures and papers on ophthalmic therapeutics in their original form in French must have approached the present work with some misgivings. Dr. Darier is an enthusiast for *novae res*. He possesses in marked degree the mental agility of the Latin race, quick to appreciate new facts, eager to traverse new paths. True, he sometimes appears to the onlookers to skip rather than to run, but then he is an artist, and a savour of art is not without its uses in dealing with the science of medicine, a science which, though yet in its infancy, is called upon to perform the feats of mature development. Dr. Darier's enthusiasm often outruns discretion, but in this book it has been curbed by the "free editorial control" which has been exercised upon the manuscript. In the end we have a sound work on the treatment of diseases of the eye, which by virtue of the large space devoted to the discussion of new methods and new drugs, forms a useful adjunct to the formal text-book.

The subject is divided into two parts, general and special therapeutics. The first commences with a chapter on methods of diagnosis, devoted to such topics as serum diagnosis and the demonstration of spirochætes. Constitutional treatment is then dealt with, stress being laid upon the technique of hypodermic and intravenous medication and subconjunctival injections. The chapter on serum- and organotherapy will prove particularly useful to the ophthalmologist, who has perforce to obtain his knowledge of these matters second-hand. It might have been expanded with advantage, and a freer citation of original papers would have enhanced its value. The ophthalmologist cannot afford to ignore serum-therapy, which now has so large a place in medical treatment, but it is a two-edged weapon, and should be used with the utmost caution. Much space is devoted to photo-electro-, hydro-, mechano-therapy, X-rays, and radium; as a rule original papers are quoted, and the reader is left to draw his own conclusions. Of more value are the chapters on drugs—anæsthetics, analgesics, vaso-dilators, vaso-constrictors, mydriatics and cycloplegics, miotics and silver compounds; their virtues and vices and the modes of their application are quite well described.

In the section on special therapeutics, the diseases of the eye are dealt with seriatim in the manner of an ordinary text-book. Too little stress is laid upon old and well-tried methods, so that the reader is liable to obtain a wrong perspective. The book, however, is clearly intended for specialists who are capable of forming an independent opinion in these matters. It would be easy to criticise many of the statements, but those most open to attack are such as only time and extended experience can ultimately settle. They are topics of constant dispute in ophthalmic journals, where they can most suitably be ventilated. In discussing cataract, glaucoma, and so on reference has to be made to operative measures. It would have been better to have relegated these matters entirely to the volume on ophthalmic surgery, where they will doubtless be treated exhaustively. The cursory remarks are of little value; on the other hand, they do not occupy much space.

We can cordially recommend the book to the consideration of advanced students of ophthalmology, and they will be well advised to look out for the other volumes of the series.

PHARMACOGNOSY IN THE UNITED STATES.

A Text-book of Botany and Pharmacognosy, intended for the Use of Students of Pharmacy, as a Reference Book for Pharmacists, and as a Handbook for Food and Drug Analysts. By Prof. H. Kraemer. Fourth revised and enlarged edition. Pp. viii+888. (Philadelphia and London: J. B. Lippincott Co., n.d.) Price 15*s.* net.

ALTHOUGH in English text-books botany is not usually combined with pharmacognosy, it is undeniable that such a combination possesses for the student of the latter science the distinct advantage that much overlapping may be avoided, and that, by selecting medicinal plants to illustrate the botanical portion, the student, while studying botany, insensibly acquires a considerable amount of information con-

cerning economically important plants. This advantage has been utilised by Prof. Kraemer to the fullest extent; indeed, it might be considered by some to have been carried rather too far, for the section on the "Classification of Angiosperms" deals with medicinal plants only. The botanical portion of the work is well written and abundantly illustrated; it is characterised by the comparatively small amount of attention given to the lower forms of vegetable life, the algæ and fungi occupying only thirty-six pages, whereas in text-books of botany these two groups are usually treated in detail that is often considered unnecessary for the pharmacognosist.

Part ii., "Pharmacognosy," is subdivided into four chapters, dealing respectively with crude drugs, powdered drugs, reagents, and micro-analysis. As the first chapter comprises only 178 pages, and deals with a large number of crude drugs, it is evident that the space allotted to each can be but small. The descriptions of the drugs are accordingly very concise, and the methods by which those that are unorganised are produced have been perhaps unduly reduced, but the constituents have received careful and sufficient treatment. Thus the accounts of the production of such important drugs as aloes, catechu, guaiacum, rubber, &c., can convey to the mind of the student but an imperfect idea of the various steps in the processes and their effect upon the drug obtained. To these details a little more space might well be given without unduly increasing the size of the work. Credit, however, must be given to the author for including a large number of drugs of comparatively rare occurrence, and thus making this section of the work more complete than is usually the case with text-books designed for the use of the student. Chapter ii., dealing with powdered drugs, has also been much elaborated. In addition to those with organised structure, it includes a number of structureless drugs (aloes, myrrh, &c.), as well as a few definite chemical compounds. The key to their identification, based primarily upon the colour, is one of the most complete that has been published. The chapter is abundantly illustrated, and contains descriptions of the microscopical characters of so many drugs that it cannot fail to be of service to the experienced microscopist as well as to the student.

Chapter iv., "Micro-analysis," deals with the identification of the crystals found in drugs and their preparations by crystallographic methods, and the time has arrived when these methods must be adopted in the study of such crystals if any real progress in that direction is to be made. It is undeniable that at present the crystals observed in drugs are often very loosely described, and that their identification frequently rests on very insufficient grounds. This part also includes the description and illustration of the crystalline forms of a number of active constituents of drugs, such as brucine sulphate, codeine sulphate, cubebin, &c., and is to be regarded as suggestive (which is certainly the case) rather than as complete.

It will thus be seen that Kraemer's text-book is a valuable contribution to the literature of pharmacognosy. It shows how medicinal plants may be utilised in the study of botany; it deals with a large number of drugs; it gives instruction in their identification in the powdered state, and it suggests lines upon which microscopical investigation may be prosecuted. The author is to be congratulated on the success of his labours. HENRY G. GREENISH.

THE CHEMISTRY OF BLEACHING.

The Principles of Bleaching and Finishing of Cotton. By S. R. Trotman and E. L. Thorp. Pp. xii+347. (London: C. Griffin and Co., Ltd., 1911.) Price 16*s*. net.

THE book before us is an attempt to blend an account of the most recent advances in the processes of bleaching and finishing of cotton goods with an equally up-to-date account of the scientific principles which form the basis of these processes. Such an attempt is comparatively rare in connection with manufacturing processes, and on that account alone the book ought to be welcomed. But when, as we find, the attempt has been highly successful, the authors must be congratulated on having produced a work of great value to all concerned in this important industry.

The book opens with an account of the structure and composition of cotton fibre, the means of testing its strength, twist, &c., followed by an account of the carbohydrates, such as starch and the sugars which are of importance to the bleacher. A full account is given of the different kinds of water, and of the means of treating it so as to make it suitable for bleaching purposes. The importance of the quality of water supplied to the works is too often overlooked by the bleacher, who ought to know that good results in bleaching largely depend on the quality of water used, and that the pure white required for some goods cannot be obtained if certain waters are used.

One of the most interesting chapters in the book is that in which the influence of bacteria in bleaching is discussed. The authors show that cotton may be infected with bacteria at almost every stage of its manufacture, and the principal causes are the following:—

(1) Impure water for steeping.

(2) Incomplete removal of protoplasmic constituents during bleaching.

(3) Allowing goods to lie about in a damp condition, especially in warm weather.

(4) Insufficient cleanliness of plant or buildings.

(5) The use of inferior materials, *e.g.* low-grade starches and glues.

(6) The careless storing of finished goods.

The results of bacterial damage are frequently coloured spots, each spot being a colony of the organism. Sometimes the whole piece of cloth becomes infected, and has the appearance of having been dyed. A piece of lace examined by the authors left the finisher apparently perfect, but subsequently developed a pink colour.

"A microscopic examination showed the presence of numerous very fine hyphæ interlaced with the cotton fibres, and subsequent plate cultures upon a starch medium similar to the dress used for the lace proved the presence of a chromogenic mould, which was

capable of producing the observed pink colour. The point was conclusively proved by infecting sound lace with the organisms."

Further, it was found that the presence of acid was necessary to develop the colour, which only appeared after about fourteen days. This explained how the goods were passed as perfect by the finishers. Naturally much space is devoted to the treatment of the cloth before the actual bleaching and to the materials and plant used in these processes. The importance of securing purity in the materials used is insisted on, and regular testing recommended. Full details are given of the Kiers used for lye boiling and washing, and there are excellent illustrations of the most improved forms of plant.

Much attention is given to the various bleaching agents, and particularly to bleaching powder. The controversy as to its composition is carefully considered, but cannot yet be said to be finally settled. Reference is made to the very recent work of R. L. Taylor (Chemical Society's Journal, 1910, p. 2541), who has shown that the action of carbon dioxide on bleaching powder liberates chlorine only and not hypochlorous acid, as had usually been supposed. On the other hand, S. H. Higgins maintains that hypochlorous acid does enter into the bleaching action (Chemical Society's Journal, 1911, p. 858).

Limitations of space will not allow us to refer to other portions of the book. Suffice it to say that the use of other bleaching agents, such as sodium hypochlorite ozone, sodium peroxide, potassium permanganate, &c., is referred to, and there is a full account of the bleaching by electrolytic solutions, and a discussion of the economy of the process. The book will be of special use to bleachers who have a sufficient knowledge of chemistry to understand the theoretical portions.

SYSTEMATIC PSYCHOLOGY.

A First Book in Psychology. By Prof. Mary Whiton Calkins. Pp. xvi+419. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 8*s*. net.

Erkenntnistheorie. Von Prof. E. Dürr. Pp. viii+362. (Leipzig: Quelle und Meyer, 1910.) Price 8 marks.

MISS CALKINS is well known among psychologists for her treatment of psychology as the science of selves rather than as the science of mental processes. In her view, the science is best treated as "a study of conscious selves in relation to other selves and to external objects—in a word, to their environment, personal and impersonal." The aim of the present book is to give a systematic account of the various psychological topics, ordinarily treated in introductory text-books, from this point of view. As might be anticipated, Miss Calkins is least successful in her method when dealing with perception, imagination, memory, and thought, although the special point of view gives an added significance to the facts, and brings a new interest for those students who have already become familiar with the ordinary descriptions. When dealing with the more individualising and active forms of consciousness—emotion, will, belief, and the religious consciousness—the author is able to benefit by her method to the full, and gives the impression of concreteness and reality so often missing in the descriptions of these aspects of conscious life. There is no chapter specially devoted to the nature of the self, but many facts generally given under this head are very fully discussed in a section on "Abnormal Psychology" in the appendix. This appendix forms quite a third of the entire volume, and contains masses of detail the enumeration and discussion of which might obscure the general line of argument. It adds very greatly to the value of the book, and is clearly arranged, and well provided with figures and diagrams. The final section contains a large number of good "review questions."

Prof. Dürr's book, though written from the psychological point of view, does at least equal justice to the metaphysical issues involved in the problem of knowledge. It is divided into three long chapters entitled, "Die Psychologie des Erkennens," "Die Wertlehre des Erkennens," and "Die Gegendstandslehre des Erkennens" respectively, and under each of these headings numerous subdivisions occur. The book cannot be accused of lack of system, and in some respects forms a compendium of philosophy with the historical and critical methods about equally represented. Its first hundred pages on the psychology of thought, however, lift it far above the ruck of ordinary philosophical text-books, and make it of the greatest value to the psychologist. The difficulties attending the various possible theories of outer perception and inner perception (introspection) are exhaustively discussed, though in small compass, and the peculiar psychological problem involved in the case of memory and recognition is clearly stated, and a solution of it attempted. Under the sub-heading "Thought," theories of abstraction, judgment, inference, and induction are briefly considered. Several paragraphs are devoted to the question of the relation of knowledge to belief. Notes at the end of the volume give the necessary references to current literature, and in many cases continue the discussion in greater detail. The one criticism to which the book is open is that difficulties are treated in too summary and dogmatic a fashion. For conversational classes or "seminars" in philosophy and general psychology, the book should prove invaluable. There is certainly no single book in English of a similar kind at the present time.

W. B.

OUR BOOK SHELF.

(1) *Introduction to Science.* By Prof. J. Arthur Thomson. Pp. vi+256.

(2) *Astronomy.* By Arthur R. Hinks. Pp. vi+256. (Home University Library of Modern Knowledge.) (London: Williams and Norgate, 1911.) Price 1*s*. net each.

(1) PROF. THOMSON has prepared an admirable introduction to the scientific section of the series of which he is joint-editor. He has an inspiring gospel to expound, and has proved himself a worthy apostle of it. Science stands for truth and righteousness, for exact observation, for progress at all costs, for that divine discontent with existing knowledge which stimulates persistent inquiry into the unknown, and

leads the true philosopher, in Sir John Herschel's words, "to hope all things not impossible and to believe all things not unreasonable."

The scientific mood, aim, and method are described by Prof. Thomson and illustrated by apt quotation from the works of active investigators. The relations of science to philosophy, art, religion, and practical life are dealt with; and the classification of the sciences forms the subject of a particularly valuable chapter. As is appropriate in a "Home University Library," the readers are assumed to come to the university with a certain foundation of preliminary knowledge; otherwise such a reference as that to "Bode's law of the relations of the planets, or Mendeléeff's 'periodic law' of the relations of the atomic weights of the chemical elements" would be unintelligible. Given this acquaintance with the broad principles of science, we can conceive no better first survey of the significance of scientific work than that which Prof. Thomson provides.

(2) Mr. Hinks has produced a volume which is decidedly superior to most popular books on astronomy, inasmuch as it is not merely a descriptive catalogue of the characteristics of celestial bodies, but a statement of leading results and a critical analysis of conclusions. The book breathes the spirit of the practical astronomer who can form his own opinion as to the value of observations and hypotheses. It suffers by comparison with some other volumes on account of the absence of illustrations; nevertheless, it is decidedly original in substance, and the most readable and informative little book on modern astronomy we have seen for a long time.

Physikalische Chemie der Zelle und der Gewebe. By Prof. Rudolf Höber. Dritte Auflage. Pp. xv+671. (Leipzig: W. Engelmann, 1911.) Price 17.25 marks.

THIS third edition of Dr. Höber's well-known work on the physical chemistry of the cell and tissues is widely different, both in extent and quality, from the modest little volume which first appeared in 1902, and interested physiological chemists as the evangel of the new lipoid theory of cell permeability promulgated by Overton and Hans Meyer.

Since that time the chemistry of colloids and of the relationships of colloids and crystalloids has made enormous strides, and the new edition is now in reality an interesting and fairly well up-to-date text-book of this domain of knowledge. It still shows, however, on account of the way the lipoid theory keeps cropping up everywhere, manifest traces of its origin, and the author is still an earnest and whole-hearted believer in an ingenious theory which has not stood the test of advance of time and growth of knowledge.

Even this sturdiest champion of the lipoid theory is driven now to admit that the experimental findings can only be explained by following Nathansohn's postulations of a mosaic cell-membrane, in which the small stones represent the lipoids and the interstitial material, a protoplasmic cement which allows a varying degree of permeability to the ions. This is accordingly a kind of dual Maxwell's demon membrane, with one kind of demon at one kind of gate letting through the lipoid-soluble bodies, and a different class of demon at a different sort of gate letting through the water-soluble bodies, and those who desire salvation for the lipoid-theory by leaving it in possession of these two demons may be congratulated on having placed it where it is well-nigh unassailable, unless, indeed, someone discovers a substance which is soluble neither in water nor lipoids and yet can contrive to get into cells.

The portions of the book which do not treat of cell permeability are well and clearly written, and give a full presentation of the subject, which may be recommended for study to those interested in the confines of physical and bio-chemistry who possess already some acquaintance with both subjects. It is not by any means a book for beginners.

BENJAMIN MOORE.

Geologische Ausflüge in der Mark Brandenburg. By K. Hucke. Pp. 155. (Leipzig: Quelle und Meyer, 1911.) Price 3.20 marks.

THIS guide for the geological student and tourist, printed in the popular black-letter type of northern Germany, should find a ready appreciation among those who travel round Berlin. The descriptions of the various excursions are clear, and there is a touch of Walther's vividness here and there, as in the account (p. 13) of the general landscape on the withdrawal of the "inland ice." Not enough is made, perhaps, of the probability that large areas of this ice stagnated in the plain, and that the withdrawal, which deposited the ground-moraine, was mainly in a vertical direction.

The index does not always guide us to the attractive generalisations which the book contains, such as the origin of the numerous lakelets and the ancient courses of the streams (p. 107). When the visitor, however, reaches a critical district he is encouraged to look beyond the immediate landscape. Formations concealed at the surface are sought in quarries underground. An interesting account is given (p. 121) of the interglacial bed of red ochre near Dahnsdorf, resulting from the oxidation of dark green iron carbonates and humates. These were deposited by water, and were subsequently preserved by boulder-clay, as a stratum 30 metres thick. The dry channels known as Rummeln (p. 136) in the elevated region of the Fläming south of Berlin are attributed to torrents from the melting ice. A new interest is thus given to these pleasant features of a land that often seems monotonous. We are told that the horizontal sheep-tracks along their sides (Fig. 55) have been regarded as river-terraces.

In the gloom of the level forest-covered regions the huge Scandinavian erratics form features of themselves (Fig. 32). The numerous photographs that illustrate this handy volume are mostly provided by the author, who has certainly shown the wide variety of deposits that may be studied in the Mark of Brandenburg.

G. A. J. C.

Playbooks of Science: Chemistry and Chemical Magic. Pp. 150. *Mechanics and Some of its Mysteries.* Pp. 120. *Flying and Some of its Mysteries.* Pp. 138. All by V. E. Johnson. (London: Henry Frowde, Hodder and Stoughton, 1912.) Price 1s. 6d. each.

BOYS who are thoroughly interested in a well-chosen hobby are the cause of much less anxiety to their parents and teachers than those who are content to idle away leisure hours. The author of these little books has for his primary aim the provision of intelligent amusement, and on the whole he has made a successful appeal to the desire young people have "to try things." "Never be content merely to read about an experiment" is the advice offered at the beginning of each book, and it is probable that many boys will be led from the performance of the tricks described to the serious study of the phenomena observed.

The two books named first are almost wholly devoted to experiments, while the third is largely a descriptive account of the various attempts to evolve the perfect flying-machine.

Der Panamakanal. By Max D. Fiegel. Pp. viii+183. (Berlin: Dietrich Reimer—Ernst Vohsen, 1911.) Price 4 marks.

Mr. Fiegel describes clearly the course of the canal now in process of construction by the United States Government; also the engineering works and machinery, and the commercial and political aspects of the enterprise. His book will provide German readers with an informative account of the position about a year ago of what in three years' time promises to be one of the most remarkable human schemes ever brought to a successful conclusion.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Weather of 1911.

Sir Edward Fry's letter in Nature of November 16, and Commander Hepworth's reply in the issue of November 23, prompt me to give expression to some ideas which I have been discussing with various meteorological friends during the last few months. What I have to say will not attempt an explanation of the phenomena of the remarkable summer and autumn of this year, but it will give an indication of the direction in which, for my part, I hope to look for an explanation of those phenomena.

I agree with Sir Edward Fry that the prevalence of anticyclones in a particular direction, or the continuance of given winds, are only part of the phenomena to be explained; I think, too, that the statement may be rightly understood in a sense slightly different from that which Sir Edward intended. I mean that this summer furnished a good deal of evidence for a proposition which includes the inference that the distribution of pressure is not in itself a complete explanation of the weather. I will state my proposition now, and afterwards explain why I make it. It is that the main outlines of the distribution of pressure are imposed upon the surface layers of the atmosphere by transmission from a region 9 or 10 kilometres high—a region which is above what may be called the physical laboratory, where rain and thick clouds are made—and that the phenomena of weather are due, not to the mere existence of the air currents which correspond with the distribution of surface pressure, but to their heterogeneity. Weather as represented primarily by rainfall is dependent on the convection of moist air, while pressure distribution is governed by changes which take place above or nearly at the top of the convective region of the atmosphere. In other words, the dynamics of the atmosphere is controlled in the upper air, while the physics of the atmosphere is a matter which concerns the lower layers.

The remarkable summer has provided evidence in support of this proposition by furnishing a number of examples of pressure distributions which might well have been rainy, and were not. The Coronation festivities were somehow preserved from the copious rainfall which, according to the pressure distribution, was their due. If pressure distribution is the cause of rainfall, 100,000 children at the Crystal Palace on June 30 ought to have got wet through, but they did not. There are many other instances of the same kind which I need not quote. Let us look at the matter from the other side.

Some time during the summer Mr. W. H. Dines sent to me the results of some work which he has done upon the correlation of various data for the upper air. Among them was the correlation coefficient between the variations of pressure at the surface and at the level of 9 kilometres. For certain groups of ascents it was so large as to show a close approximation to proportionality. That is, of course, not surprising, because the variations at the surface and at 9 kilometres are certainly not independent; but what was surprising to me was that the standard deviations of pressure at the two levels in the cases under investigation were very nearly equal. Thence it follows that the pressure variations at 9 kilometres level (with two-thirds of the atmosphere below it) are not merely proportional to the variations at the surface, but the same in magnitude; and as they are certainly transmitted to the surface, it follows, further, that the variations at the surface are practically accounted for by the variations that occur at 9 kilometres. We are accustomed to urge the importance of the study of the upper air for increasing our knowledge of meteorology; but, so far as I know, we have not recognised that it was so directly responsible for steering our surface air currents.

Mr. Dines's variations were those shown between the individual balloon ascents and their average. Looking into a series of charts for the upper air recently published by Prof. Rotch, I came upon another step in the proof. In the charts Prof. Rotch gives the average wind velocity at 30,000 feet (9 kilometres) and the atmospheric density there. The product of these two is about the same as for a point near the surface, whence it follows that for Blue Hill the pressure gradient at 9 kilometres, which is proportional to the product, is the same as for the surface; in other words, not only are the chronological changes transmitted to the surface from 9 kilometres, but the average pressure distributions are similarly transmitted. In a discussion at the Meteorological Office on October 23 I was reminded that these conclusions are not new. The inverse proportionality of velocity and density of air is known as Egnell's law; and the approximate constancy of pressure gradients up to 9 kilometres was pointed out to the British Association by Gold and Harwood in 1909. But the idea of looking to the level of 9 kilometres for the outlines in full scale of our surface distribution of pressure is new; and it seems to me to be possibly the beginning of a new era in the endeavour to explain such phenomena as those of the past summer.

I cannot, at this stage, give particulars as to the details of the application of so general a proposition to special cases, such as circular revolving storms, the northern sides of which may be confined to the lower strata, nor can I say whether the application of the proposition is limited to certain parts of the world. I think it must be. It will be remembered that M. Teisserenc de Bort computed mean isobars at 4 kilometres for January and July that showed the average circulation of the upper air in each hemisphere as a great cyclonic depression, with centres at the poles. It is not likely that there is any great change of distribution between 4 kilometres and 9 kilometres. At Blue Hill the winds at 3 kilometres vary between W.S.W. and N.N.W., and these, again, should agree with the pressure distribution. We know from the study of the points where sounding balloons land that the westerly circulation is not always to be found aloft. We know, also, that at 9 kilometres the variations of temperature from day to day are as large as, or larger than, those at the surface. Hence we may conclude that the pressure distribution at 9 kilometres corresponds with a cyclonic circulation of westerly winds round the pole, periodically, but perhaps not regularly, invaded by winds from some northerly quarter, with marked changes of temperature. This will be recognised as merely a rough description of a series of **V**-shaped depressions, which also, on the average of the month, would give a westerly circulation. Possibly, in reality, the **V**-shaped depressions at 9 kilometres are made up of comparatively warm westerly winds with repeated incursions of cold air from the north or north-west, giving phenomena similar to those which have been described in recent discussions of line squalls. In the results of Mr. Cave's observations of pilot balloons there is evidence that **V**-shaped depressions at the surface sometimes originate with northerly winds at high levels.

If this is so, our failure to explain the outlines of the distribution of pressure by means of the surface conditions is itself explained. Mr. Dines's recent paper before the Royal Society shows how futile is the endeavour to explain them by reference to temperatures in the layers below 9 kilometres. They come from above, and their shape at any time is governed by causes in the consideration of which we must treat the globe as a whole. Our first step in explaining, for example, the recent succession of gales would be to note whether the westerly circulation in the

region of cirrus clouds had become greatly intensified. We may infer that that circulation depends, at least, in part on the differences of temperature at different latitudes, because the winds are strongest in the winter, when the difference of temperature between the tropics and the pole is greatest; but we cannot yet describe the mechanism of the process nor the variations from year to year. On the other hand, rainfall seems to have to do rather with the small variations of pressure, which elsewhere I have called the embroidery of the barogram, than with the main features of the barogram. Considerations of space prevent my pursuing here the suggestions that this proposition entails. I need hardly say that the subject is not exhausted by what I have said. W. N. SHAW.

November 27.

The Inheritance of Mental Characters.

MR. WALKER sent me, before publication, the letter which appeared in NATURE of November 23. In reply I explained that, though I have insisted elsewhere that the words *inborn*, *acquired*, and *inheritable* are often incorrectly used, yet in my paper to the Eugenics Education Society I did not define the meanings of them, partly because my space was limited and partly because I thought no misapprehension could arise in the minds of my audience. None did arise. But I learn, with surprise, that some would have arisen had my critic been present. I used the words exactly as they are commonly used in biological literature, terming such characters as heads and instincts inborn and inheritable, and such characters as scars and a knowledge of Latin acquired.

In Mr. Walker's book, "Hereditary Characters," he was good enough to reproduce many of my conclusions almost in my own words; for example, "In considering the mental characters of man we are forced to the conclusion that almost all are acquirements, and that very little besides consciousness, memory, capacities for making various acquirements, and a few instincts is inborn." This is precisely my opinion as elaborately set forth, not only "on all previous occasions," but in the very paper he criticises. The astounding thing is that he should imagine that it is, or may be, also the opinion of Prof. Karl Pearson, whose statement, he thinks, "may be loosely expressed and open to misinterpretation," but "which does not appear, on the face of it, to be at variance with his own views." I fear Prof. Pearson will pray ardently to be delivered from his friends.

I must complain that the sentence Mr. Walker quotes from my paper is, in the absence of its context, open to misinterpretation. I was not merely railing. The following is the passage from which it is taken. Prof. Pearson does not use the word "inborn"; but if the word "inheritable" or "physical" be substituted for it, my meaning is unaltered

". . . Here we have an example of a conclusion based, like many more of the conclusions of biometricians, on an ascertained correlation. It is assumed that, since offspring reproduce parental mental characters in the same degree as their physical characters, therefore, if the latter are inborn, the former must be inborn also. In other words, it is assumed that one kind of sameness necessarily involves another and a different kind of sameness."

Now, though I have collected no family histories bearing on the subject, I think that no one will deny that such characters as heads, hearts, lungs, livers, and the like are inborn and invariably present in parents and offspring—at any rate in offspring that reach school age. Here we have absolute certainty of inheritance. Again, I think no one will deny that parental birth-marks, moles, and the like, are also inborn, and that they are hardly ever, if ever, reproduced by offspring. Here the degree of inheritability is zero. Between these extremes of inheritability lie the degrees of inheritability of all the other characters. Some, like ten fingers and ten toes, are reproduced almost as certainly as heads; others, like eye-colour and hair texture, with less certainty; others with still less certainty; and so on, and so on, until we reach characters the inheritability of which is scarcely greater than that of birth-marks and moles. Plainly, then, since the inheritance of inborn characters varies between certainty and zero, Pearson's statement is without significance—void of all content. Founded with such an air of scientific accuracy on statistics and family histories which have such an appearance of scientific precision, it is so vague as to be quite nonsensical. By the use of his method any character you like may be "proved" to be inborn; for, if only you seek conscientiously, you will be sure to find another undoubtedly inborn, which is reproduced by offspring in about the same degree. Thus all English children have heads, and all speak English. If, then, you are satisfied with the method, you may conclude that English speech in English children is "bred, not created." Or, alternatively, that English children acquire their heads—for you are happy in always having these alternatives to choose from.

G. ARCHDALL REID.

Southsea, November 26.

Amedeo Avogadro.

EXACTLY a century has passed away since the eminent Italian physicist Avogadro published the law which, bearing his name, is now familiar to every elementary student of chemistry or physics. Owing to various causes, Avogadro's labours were but little appreciated, and though he occupied a foremost position among Italian men of science the scientific world in general evinced but little interest in his work. Even the indefatigable Kopp failed to realise the importance of his speculations, with the result that his first history of chemistry contained no reference at all to them. Like Carnot's, Avogadro's writings had to await an interpreter and supporter. In this respect, however, fortune proved more than kind, and in his countryman Cannizzaro, Avogadro obtained an illustrious disciple and a brilliant exponent of his doctrine. But while it is true that the name of Avogadro is now widely known, it is no less true that the record of his life seems to have escaped biographers and historians alike, a statement which will be substantiated by a search through the ordinary English works of reference.

Count Amedeo Avogadro di Quaregna came of a distinguished and noble family of Biella, a small town some way north of Turin, in Piedmont. Various members of the family had won fame in the courts or on the field, but the name is unknown to the world at large except through the work of this student of physical science. Amedeo's father, Count Filippo, married Anna Vercellone, of Biella, and on August 9, 1776, their son was born at Turin, the birthplace of Lagrange. In obedience to his father's wishes young Avogadro studied law. He received his diploma on March 16, 1796, and during the next few years occupied positions in various branches of the law offices. In April, 1801, he was appointed secretary to the Prefecture of the Eridano province. His natural inclination for mathematics and physics, however, led him to carry on his studies, and with his brother Felice he wrote, and presented to the Academy of Sciences of Turin, two papers, in 1803 and 1804, the first being on electricity and the second on the nature of metallic salts. For this work the brothers were nominated corresponding members of the academy on July 5, 1804. Amedeo now obtained permission from his father to follow the career of his own choosing, and after a short course of study he became in 1806 a demonstrator at the Royal College of the Provinces. Three years later, on November 7, 1809, he was appointed professor of positive philosophy (physics and mathematics) in the Lyceum at Vercelli, where he remained until 1821. It was during the early years of his residence at Vercelli that he produced the two memoirs which have immortalised his name. Both the memoirs were published in the *Journal de Physique* of De la Methérie. The first, which appeared in 1811, was entitled "Essai d'une manière de déterminer les masses relatives des molécules élémentaires des corps, et les proportions selon lesquelles elles entrent dans ce combinaison"; the second appeared in 1814, and was entitled "Mémoire sur les masses relatives des corps simples, ou densités présumées de leur gaz," &c. Avogadro returned to the same subject in a memoir which he published in 1821, 1826, and in 1849, and he investigated other problems bearing on the same subject. His other researches included questions in electricity, chemistry, electrochemistry, specific heat, and the expansion of bodies.

On October 6, 1821, Victor Emmanuel I. instituted the first Italian public chair of higher physics, and in November Avogadro was appointed to it. Owing to political troubles the post was suppressed two years later, and Avogadro, after a brief interval, was given a post at the Regia Camera dei Conti, where he continued with undiminished activity his cherished studies. In January, 1832, Carlo Alberto restored the chair Avogadro had occupied, but appointed to it the famous Cauchy, who, it will be remembered, had been compelled to leave the Collège de France and his seat in the National Institute of France owing to the Revolution of 1830. Cauchy had been elected, amidst a storm of indignation, to the seat in the institute vacant by the expulsion of Monge, and he was now in his turn suffering the vicissitudes of fickle fortune.

Towards the end of 1833 Cauchy left Turin to take charge of the education of the young princes at Prague, and Avogadro was again appointed to the position for which he was so well fitted. He remained professor of physics until 1850, when he resigned owing to advancing age, and was succeeded by his favourite pupil, Felice Chiò. His scientific work was continued almost to the end of his life; and he died at Turin on July 9, 1856, having nearly reached the age of eighty.

Avogadro's memoirs, numbering some forty or fifty, appeared in the *Journal de Physique*, the *Annales de Chimie et de Physique*, *Brugnatelli's Journal*, and other periodicals. Among his works was a huge compilation of 3700 pages, in four volumes, on physics, which was published at the expense of Carlo Alberto. His principal studies, as we have seen, related to the physical properties and the internal structure of bodies, and the law—that equal volumes of gas contain the same number of molecules—to which his name is attached perpetuates his memory. Ampère independently enunciated the same doctrine; but in point of priority Avogadro's claim is beyond dispute.

He was a man esteemed in private life for his kindness, affability, and sincerity. His habits were noted for their simplicity, and he was as modest as he was learned. The year following his death a marble bust in his honour was placed in the University of Turin. In the Scuola Professionale at Biella is another bust, with the inscription—

I GAS A PARI CONDIZIONI
DI PRESSIONE E DI TEMPERATURA
IN EGUALI VOLUMI CONTENGONO
UN EGUAL NUMERO DI MOLECOLE.

Last year a project was formed to celebrate the centenary of the enunciation of his law, but I do not know whether the scheme was carried through or not.[1] The above details have been obtained from the short biography of Avogadro by Alfonso Cossa, for a copy of which I am indebted to the kindness of Prof. Naccari, the present occupant of the chair of physics at Turin. EDGAR C. SMITH.

Hong Kong, October 23.

[1] See NATURE of October 26, p. 557.—ED.

Characteristic Röntgen Radiations.

In the September number of *The Philosophical Magazine* there appears a paper by Prof. Barkla, in which are tabulated the results of some further experiments on characteristic (fluorescent) Röntgen radiations. It appears that some of the elements of high atomic weight give "two lines in the fluorescent spectrum." Optical analogy suggests that there may be some simple relation connecting these spectral lines. Such a relation can, indeed, be readily obtained, and I should like to be allowed to direct attention to it.

In a paper on the production of characteristic Röntgen rays (Roy. Soc. Proc., 1911), I showed that for the elements from Al upwards (which gave characteristic rays in series K) the radiation they emitted could be defined, indirectly, in terms of their atomic weight. It was shown that the radiation characteristic of an element of atomic weight w is the same (when tested by penetrating power) as the most penetrating of the Röntgen rays emitted from an antikathode bombarded by kathode rays of velocity equal to kw, where $k=10^8$.

Thus the radiation characteristic of Se would be emitted by kathode rays of velocity $7{\cdot}92\times10^9$ cm./sec. ($w=79{\cdot}2$), that characteristic of Cu by kathode rays of velocity $6{\cdot}36\times10^9$ cm./sec. ($w=63{\cdot}6$), and so on. Such kathode rays as would produce a characteristic Röntgen-radiation may be conveniently termed equivalent kathode rays. Thus we can define a radiation the λ/ρ of which is known, in terms of the velocity of the equivalent kathode rays, and so indirectly in terms of the atomic weight.

Prof. Barkla tells us that Bi gives out (in series L) a radiation of very nearly the same penetrating power as that from Se in series K (the actual values of λ/ρ are 19·0 and 18·9). From this it follows that the equivalent velocity for Bi (series L) is the same as for Se (series K), *i.e.* $7{\cdot}92\times10^9$. Thus, if we adopt series K for our standard, we can say that Bi behaves (for series L) as though it were an element of atomic weight 79.

The actual atomic weight of Bi is 208, and it behaves (for series L) as if its atomic weight were $w'=\frac{1}{2}(w-50)=79$; thus the two possible spectral lines for Bi are defined in terms of the two equivalent kathode rays of velocities $2{\cdot}08\times10^{10}$ cm./sec. and $7{\cdot}9\times10^9$ cm./sec.

The expression

$$w'=\tfrac{1}{2}(w-50)$$

holds fairly well over the greater part of the range studied by Prof. Barkla, as the following table shows.

Element	w	w'	λ/ρ (calculated)	λ/ρ (observed)
Sb	120·2	35·1	375	435
I	126·9	38·5	298	306
Ba	137·4	43·7	248	224
W	184·0	67·0	35·0	33
Pt	195·0	72·5	25·5	27·5
Au	197·2	73·6	23·8	25
Pb	207·1	78·6	20·0	20
Bi	208·0	79·0	19·1	19

The calculated values of λ/ρ have been obtained by interpolation of w' in a w, λ/ρ graph.

The observed value of λ/ρ for Sb is almost certainly too high, since in some experiments with Sb (August, 1910, Proc. Camb. Phil. Soc.) I found that the equivalent velocity was about $3{\cdot}6\times10^9$ cm./sec. (compare w' above). The agreement otherwise is as good as could be expected.

In conclusion, formulæ of the type to which attention has just been directed ($w'=A.w+B$) may possibly prove useful to experimental investigators in suggesting new "lines" and indicating where to look for them.

R. WHIDDINGTON.

St. John's College, Cambridge, November 16.

A Suggested Reform in Palæobotany.

In a paper in the *Annals of Botany* for October (pp. 903–7, text figures) I brought forward conclusive botanical evidence that the Cretaceous fossils from the Amboy Clays of North America, hitherto known as *Ophioglossum granulatum*, Heer, are not only not Ophioglossums, but are not ferns at all, and belong to the widely distinct family of Gymnosperms, in the genus Pinus.

This result, in itself of not much importance, forms the text of a general recommendation to palæobotanists, which is as follows:—In the interests of the sciences of palæobotany, geology, and botany, I "urge that the lists published by palæobotanists should be printed in two forms, and that the names of species of leaves, stems, &c., of which there is a reasonable security of determination, should be differentiated from those in which there is no guarantee at all that the actual nature of the plant has been discovered. Any tri-nomial system is cumbrous; but those who publish on fossil plants might print their names in type of two kinds, which would indicate which species are doubtful. I should like to suggest that, instead of using italics or ordinary capitals as is usual in printing the names of species and genera, such doubtful plant-impressions should be printed in Gothic lettering. This would indicate that our knowledge about them is mediæval —of the Dark Ages—and would further save the inconvenience of tri-nomials, while it would indicate immediately the difference between the established and the doubtful determinations. As information accrued about a

specimen it could easily be transferred to the clear Latin italics.

"Thus the transference of Ophioglossum granulatum, Heer, to *Pinus granulata* (Heer) would indicate that an exceedingly doubtful determination had been replaced by one with some scientific basis. Any worker in another branch of science, seeing O. granulatum, in Gothic, would be warned at least to look into the grounds for the determination for himself before he—let us imagine—used the record for his stratigraphic work in correlating horizons, or in writing up the early history of the Ophioglossaceæ, when he would otherwise assume that the living genus was represented in Cretaceous times in the Ambay Clays of North America. This is merely an illustration of what is very widely spread in fossil botany; but it may serve to give point to the general proposition that the time has come when it would be of real service to the science to attempt a conscientious distinction between valuable and doubtful determinations, and that Gothic lettering might give us an easy indicator.

"The need for this is all the greater, because the results of palæobotany touch so many other fields of research, in animal palæontology, geology, and palæogeography, as well as botany itself. Workers from these other fields are seldom able to estimate the evidence that they are taking to build into their own work, even had they the time to go into the details; and thus a single error gets widely disseminated. Often it is not entirely the fault of the one who originally described the fossil, for he may say in his text that the nature of the specimen is doubtful, and that, in default of better evidence, he gives a certain name with hesitation. That name, however, once given, is quoted and put into lists without being in any way distinguished from the rest; and the results are detrimental to the advance of true knowledge in every way. It is no solution to call every leaf, as some conscientious workers do, 'Phyllites': different things, however doubtful, must have distinct names, and the use of Gothic characters for the very doubtful ones would greatly tend to 'create confidence' in the science of palæobotany."

MARIE C. STOPES.

The Unit of Momentum.

DOUBTLESS all teachers of experience are agreed that in dealing with the measurable quantities considered in mathematics and physics there is great difficulty in giving to students a clear idea of the quantities measured unless a definite name be given to the unit in terms of which measurement is made.

Until the word "radian" was introduced, circular measure was a stumbling-block to all beginners in trigonometry; the sentences "the circular measure of this angle is 1·7" and "arc over radius equals 1·7" make little impression on the untutored mind; but the sentence "this angle contains 1·7 radians—the radian being rather more than 57°" is as easy of comprehension as "the value of this is $2\frac{1}{2}$ guineas—the guinea being 21 shillings." So in electricity, without the names ampere, volt, ohm, &c., the learner would be—as he was thirty years ago—lost in hopeless vagueness.

In mechanics we have given names to almost all the units; why not give one to the unit of momentum? I venture to suggest for general use the names which I have myself made use of for many years, and have found helpful in inducing clear thinking on the part of my students; they are analogous to the names of the units of work.

Thus the work done by a force 1 lb. acting for 1 ft. is one ft-lb.

The momentum produced by a force 1 lb. acting for 1 sec. is one sec-lb.

The work done by a force 1 poundal acting for 1 ft. is one ft-poundal.

The momentum produced by a force 1 poundal acting for 1 sec. is one sec-poundal.

The work done by a force 1 dyne acting for 1 cm. is one cm-dyne (erg).

The momentum produced by a force 1 dyne acting for 1 sec. is one sec-dyne.

Similarly we may speak of a sec-ton and a sec-tondal.

The advantage of the above names is that they emphasise the essential distinction between momentum and kinetic energy, viz. that one measures what I may call the time-effect of a force and the other its space-effect; or, to put it differently, when we know the momentum of a moving body we know *how long* a given force must act to produce the motion, and when we know its kinetic energy we know *how far* the force must act. This point of view seems to me far more desirable than the suggestion to the beginner that momentum is mv, or "mass × velocity"; such a suggestion he must either receive in deadly apathy or he must worry his brain with the impossible task of trying to conceive how mass can be *multiplied* by velocity: his teacher may try to slur over the difficulty for him by a word-juggling substitution, and say momentum is the *product* of mass and velocity; but then, what is a product? In the mathematical sense of the word it is the result of multiplication; in the non-mathematical sense it is anything resulting from or produced from certain others; and in this latter sense kinetic energy is just as much the product of mass and velocity as momentum is. So, also, the time-honoured but vague phrase "quantity of motion" could be used to express kinetic energy with quite as much aptness as to express momentum.

Using these names, we would teach—

"The momentum of m lb. moving at v f.s. is mv sec-poundals, or mv/g sec-lbs.; its K.E. is $\frac{1}{2}mv^2$ ft-poundals, or $\frac{1}{2}mv^2/g$ ft-lbs." "The momentum of m grams moving at v c.s. is mv sec-dynes; its K.E. is $\frac{1}{2}mv^2$ ergs (cm-dynes)."

F. R. BARRELL.

The University, Bristol, November 7.

I AM in the habit of saying, "the amount of momentum is 12 in C.G.S. units" or "the amount of momentum is 12 in engineers' units." The use of such a complex name as "gram-centimetre per second" would be absurd. Now Mr. Barrell has made an excellent suggestion; the names sec-dyne with all students, and sec-pound with such students as use engineers' units, are not only short and easy to remember, but they keep before the student the fundamental fact that force is time rate of change of momentum. It seems to me, however, that at the start we must define momentum as mv, and boys must from the start learn that they are no longer multiplying mere numbers. I never found that a boy had any difficulty if his master did not create one. A boy knows at once that if a distance of 100 yards is passed over in 20 seconds there is an average speed of 5 yards per second; he has no difficulty in dividing space by time, but his teacher may create great confusion in his mind if he philosophises about it.

JOHN PERRY.

Fish and Drought.

IN my letter on "Fish and Drought" published in NATURE of November 23 there is an error, due, without doubt, to a mistake in my MS., which may confuse the reader. In the tenth line from the bottom of the right-hand column of p. 108 the word "north" occurs; it should read "south."

It has been pointed out to me by friends who have read the letter that the final paragraph is rather difficult to follow. With your permission I beg to take this opportunity of rectifying its expression, as follows:—

In conclusion, I think that the observations above recorded show that the material of geological formations need not necessarily have been "laid down"; it may have been produced *in situ* like the mud in the ditch round the Park of Marchais, and that the enclosure in it of animal remains may have been in some cases due to a voluntary act of self-inhumation, undertaken, perhaps usually, with a view to self-protection. They also show that two neighbouring strata, the one carrying abundance of life and the other being destitute of it, may nevertheless be contemporaneous in date and conterminous in locality of formation.

J. Y. BUCHANAN.

November 26.

THE INTERACTION BETWEEN PASSING SHIPS.

ONE of the prominent questions of the day in naval architecture circles is that of the influence of passing ships upon each other. It has been known for many years that such an influence exists between vessels in confined waters, canals, for example, and for such canals there are usually stringent regulations as to speed and manner of passing of ships. Such conditions are, of course, extreme, but the narrowness and shallowness of the canal, merely intensify a phenomenon which is present in deeper or broader waters, but not always apparent.

tendency for it to cant in towards two; in the second position the forces are all tending to draw the two ovals together, there being throughout the body of water between them less pressure than exists on their outer sides. In the third case, oval one is subjected to forces tending to cant it towards or away from two, as the stern is in a field of pressure below normal on its nearer side, and the bow in a field of increased pressure on the inner side.

The extent and importance of these forces will depend on the lateral distance apart, on the bounding conditions of the fluid, and on the speeds, both absolute and relative, of the ovals. In order to give an indication of how greatly this influence is increased

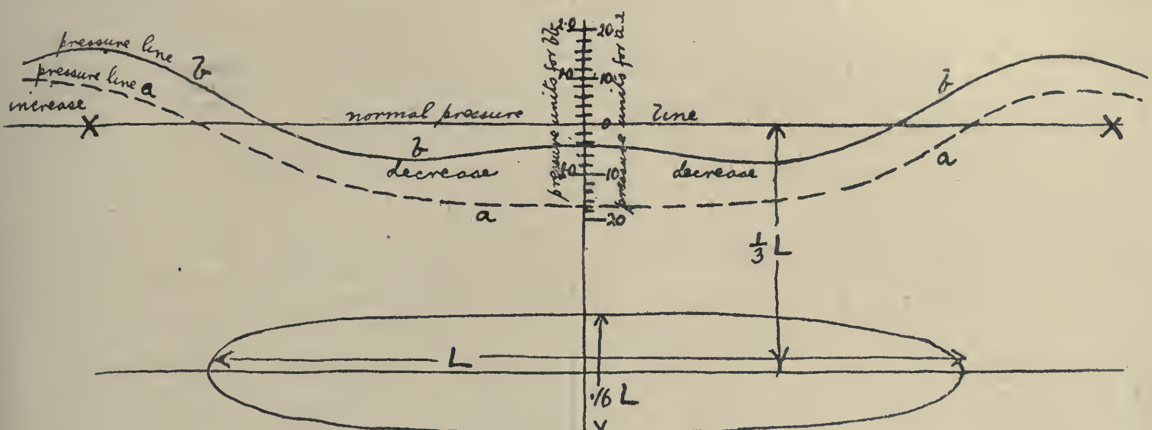


FIG. 1.—Variation of pressure around an oval along the line X X.

A ship's form unfortunately cannot be expressed by any formula, and its stream lines cannot be easily calculated, but by considering the case of two ovals formed by "sources and sinks," we can get a rational idea of the character and variation of the forces which come into play. The equation for the pressure at any point in the fluid surrounding an oval is given by:—

$$-\frac{p}{w}=\frac{v^2 f}{2g}\left[\left(\frac{\cos\phi_1}{r_1^2}-\frac{\cos\phi_2}{r_2^2}\right)+\frac{f}{4}\left(\frac{1}{r_1^4}+\frac{1}{r_2^4}-\frac{2\cos(\phi_1+\phi_2)}{r_1^2 r_2^2}\right)\right] \quad (1)$$

where r_1, ϕ_1 and r_2, ϕ_2 are distance and angle from source and sink respectively, and f varies with the distance between source and sink and length of major axis, and v^2 is the relative velocity of fluid and oval.

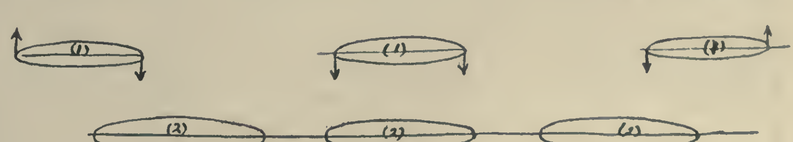


FIG. 2.—Action between passing ovals.

The line b b in Fig. 1 shows the variations of the pressure from the normal, along a line distant one-third the length from the centre line, and it can be seen from this that, speaking generally, there exist at each end of such an oval fields of increased pressure, and that the space between them is a region of diminished pressure.

If two such ovals are moving in the fluid, it can be readily seen that the variations of pressure due to one will modify the pressures due to the other, and that the pressure conditions on the sides of the ovals nearer to each other are different from those on the outer sides.

In Fig. 2 the ovals are shown in three positions relative to each other, and the arrows at each end of oval one show the motion which the forces due to interference tend to set up. If one is overtaking two, in the first position shown, there will be a strong

when a body moves from deep to shallow water, the curve a a has been drawn in Fig. 1. This shows the variation of pressure for a plane oval (*i.e.* with two-dimensional flow), having the same axes as the oval for which curve b b has been drawn, and it will be noticed that the scale of a a is one-tenth that of b b.

Such general reasoning, however, although showing the nature of "interference," does not give a measure of the forces involved with actual ship forms under similar conditions, and to obtain this experiments must be made with models in water of different depths.

Experiments conducted in 1898 in a German canal with barges having a sectional area approximately one-third the sectional area of the canal, showed a region of considerable excess pressure in front and at the rear of the barge, and on the bank for the whole length of the barge a remarkably strong negative current or diminution of pressure.

The experiments made by Naval Constructor D. W. Taylor in the Washington Tank, throw a considerable light on the problem. The ship-shaped models used were of the same length and were run at an average speed corresponding to 13·5 knots for 500-feet ships.

The results of the experiments show that in very deep water such ships do not begin to influence each

other appreciably until their distance apart is less than 0·8 of their length, and that this influence is becoming very noticeable when the distance apart is 0·6 of their length. It was also found that, with the models in any given position, the forces involved varied as the resistance of the models, *i.e.* for these speeds roughly with the square of the velocity as theory would lead us to expect.

The variations of the forces as one model was moved to varying fore and aft positions relative to the other (keeping the lateral distance the same) showed the very strong tendency which any model had to cant into the stern of the other model which it was overtaking, how this tendency to cant changed, as the models were brought abreast each other, to a strong sheer of each model towards the other, and, finally, when one model was shifted so that its bow was well forward of the bow of the other, it had a strong desire to cant away from the latter. This is all much the same as the consideration of our two ovals has led us to expect, and goes to show that passing vessels, even in deep water, are liable to exert strong forces upon each other. If they are moving at approximately equal speeds in the same direction, *i.e.* if the forces are maintained for a considerable time, then these forces will tend to produce erratic movements of the ships, requiring careful navigation if a collision is to be avoided.

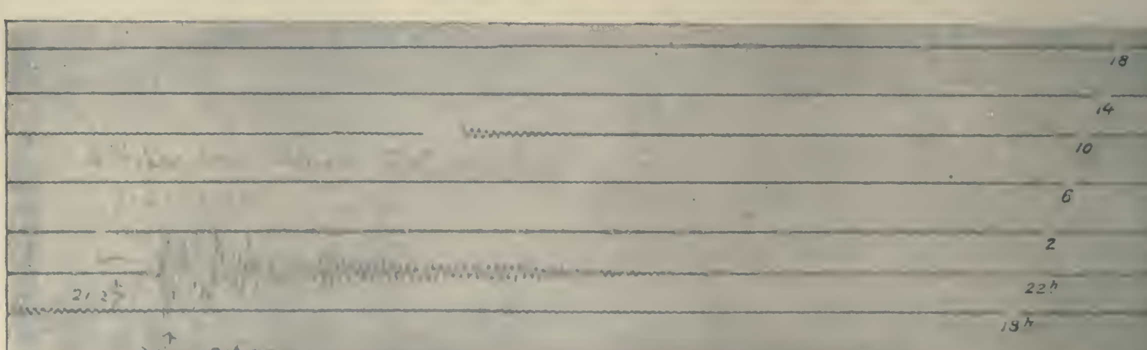
No experiments have been made up to the present to test this suction or interference in shallow water, except those made recently at the National Experiment Tank at Teddington in connection with the *Hawke* and *Olympic* collision; but the general reasoning already given is good ground for supposing that such influence would be greatly magnified as a vessel passed from deep to shallow water.

THE CENTRAL EUROPE EARTHQUAKE, NOVEMBER 16, 1911.

ON the night of November 16, at 10.25, western Germany, eastern France, and Switzerland were rudely shaken by an earthquake of exceptional intensity. At Frankfort-on-Main houses were cracked. In Freiburg, Stuttgart, Munich, Mülhausen, and in other towns, chimneys and roofs were damaged. The valley of the Upper Rhine was shaken throughout its length. At Constance two colossal statues fell from the Post Office upon the pavement. According to reports in the daily papers, walls were split, church spires were wrecked, roofs were shattered, people were "thrown out of their beds," telephone and telegraph communications were destroyed, and the path of the earthquake was marked by ruin from Magdeburg to Berlin. Everywhere terror-stricken people "rushed" from their houses, and at Ebingen 500 of its inhabitants gathered round a fire during the night and recounted their weird experiences.

It is difficult to reconcile these descriptions of widespread ruin with the fact that there does not appear to have been a single casualty. One thing about which we can be certain is that the earthquake was felt eastward to Erfurth, westwards to Nancy, and southwards to Milan. At least 17,000 square miles of Central Europe received a shaking perceptible to the greater number of its inhabitants. Outside this area it was recorded by many seismographs. Whether the disturbance was or was not recorded in very distant places largely depends upon the character of the instrument employed to record teleseismic motion. Experience has shown that seismographs recording photographically pick up these effects at greater distances from an epicentral area than those which register mechanically.

The accompanying seismogram of east and west motion, as recorded in the Isle of Wight, shows that the disturbance commenced at 9h. 27m. 30s., and reached a maximum two minutes later. The inference from this is that the origin was 5 degrees or 300 geographical miles distant. That it was a near earthquake is also indicated by the rapidity of the vibrations. At the distance indicated we reach the upper part of the Rhine Valley, a district from Frankfort, through Bâle to Constance, well known to seismologists as an earthquake-producing region. In a popular sense the upper part of this is a valley, but from the manner in which it originated it is sometimes referred to by geologists as a *graben*, or piece of territory that has fallen downwards between two faults. In this instance one of these faults borders the Vosges and the other the Black Forest. It is a tectonic displacement along which adjustments from time to time have taken place, each of which represented a relief of strain and was accompanied by a shaking. One well-known paper solemnly informs its readers that this earthquake was of Teutonic origin, and, considering the country in which it was made, the statement may be regarded as correct.



At present it cannot be said with certainty that this disturbance originated from the chief of these tectonic lines or from one of their numerous offshoots. To the right and the left of the Rhine Valley the country is cracked through and through with many minor fractures, a sudden movement on any one of which might be capable of producing all that has been observed.

J. MILNE.

DUST EXPLOSIONS.

THE explosion of a mixture of dust and air, supposed by the head of the firm of Messrs. Bibby Brothers to have been the initiating cause of the catastrophe which destroyed and set on fire part of their oil-cake and seed-crushing mills in Liverpool on the night of November 24, is the most probable explanation of that occurrence. It appears that some of the seeds which contain no oil form an exceedingly fine powder when crushed. The hypothesis is that fine powder produced in this manner became disseminated in the air of the chamber, thus forming an inflammable mixture, and was ignited by some means not ascertained, possibly by a stream of sparks due to friction between the grinding rolls, possibly by an open light. Be this as it may, a violent explosion took place, shattering that portion of the mill in which crushing is carried on, and causing the deaths of thirty-one persons, and, more or less, serious injuries to 112 others.

This event recalls the disastrous explosion which destroyed the Tradeston Flour Mills in Glasgow in 1872, and was investigated and reported upon by Profs. Rankine and Macadam. On that occasion Prof. Macadam stated: "When the whole of the conditions required theoretically for the most disastrous explosions are practically realised, the increase of pressure is equal to eight atmospheres, or 120 lbs. per square inch, which must necessarily bring about a violent explosion and wreck any ordinary building."

Another notable explosion of the same kind, which stands unrivalled in the magnitude of the havoc wrought by it, wrecked the Washburn Flour Mills at Minneapolis on May 2, 1878, and set fire to six other mills and a number of buildings in the neighbourhood. Profs. Peckham and Rye, who were commissioned by the coroner's jury to investigate the circumstances in which it took place, made a series of experiments in closed boxes to test the explosibility of a variety of powdered substances, amongst others various flour mixtures and coal dust. The powders were blown into the box with bellows and ignited by an open light. As the result of their experiments the investigators came to the conclusion "that practically all finely divided highly carbonaceous material would explode under the conditions tried."

Explosions in grinding mills are not, perhaps, so infrequent as might be imagined: a dust explosion occurred in an adjoining block in Messrs. Bibby's mill four years ago, when several workmen were injured, and many similar explosions have taken place in flour mills from time to time, causing damage and setting fire to the buildings, but not heard of beyond the immediate locality, and then probably reported merely as fires.

Most mill owners seem to be now alive to the risks they run from this cause, and take the precaution of limiting the dimensions of the spaces in which mixtures of dust and air are necessarily formed, and excluding open flames from them. Besides flour mills, sugar refineries, starch works, and factories for the preparation of madder, lycopodium powder, flour of sulphur, and so on, have all been the scenes of explosions of this kind. Lycopodium powder, which consists of the spores of *L. clavatum*, the stag-horn moss, is amongst the most inflammable of these substances. It burns with a sudden flash of yellow flame and with a hissing noise, probably due to the bursting of the individual spores, when its mixture with air is ignited.

Lastly, the inflammable, and under certain conditions explosive, nature of a mixture of air and coal dust is now becoming better understood and appreciated, and has recently constituted the subject of articles contributed by the present writer to the pages of NATURE (vol. lxxxvi., pp. 223, 595).

W. GALLOWAY.

THE TEACHING OF MATHEMATICS.[1]

THESE two reports on mathematical teaching cover very different ground, and are treated from very different points of view. The report of the London County Council refers particularly to elementary schools, though in many places it deals with general questions of mathematical teaching that apply to schools of all types. The New South Wales report refers entirely to the work of secondary schools. Again, the L.C.C. report is drawn up by a body consisting mainly of teachers in the closest touch with the child, and, throughout their report, they consider the state of development of the child's mind and the wide differences there must be between the children in the future. In marked contrast to this, the N.S.W. report does not seem to be based on an intimate knowledge of the minds of average pupils, but seems to aim only at the production of future mathematicians.

The L.C.C. report opens with a chapter devoted to general questions of mathematical teaching; then follows an excellent chapter on the first steps in arithmetic. The next chapter, "On the coordination of arithmetic with science and other subjects of the curriculum," is the most suggestive chapter in the report; there are many excellent suggestions for changing the arithmetic lesson from a dull grind to a really attractive lesson, instilling into the pupils a truly scientific spirit. The only doubt that arises in our mind is whether the second-rate teacher will keep a proper balance between the illustrations leading up to new ideas and the new ideas themselves—recent experience in geometry shows that a word of warning is necessary. The fourth chapter deals with the logical and computative sides of the subject—some of the examples considered seem to be the diabolical inventions of the examiner or the text-book writer. Finally, we have a summary of the answers to questions sent round to teachers, examiners, and inspectors—some of these are of great interest; the most interesting perhaps is taken in the first chapter; it deals with the "relative capacity of boys and girls for mathematics":—

> "Opinions expressed were in favour of a greater general capacity for mathematics, especially as tested by the solution of problems, among boys, and of greater neatness, accuracy, and conscientiousness in carrying out rules and processes, among girls. It was, however, stated that many brilliant exceptions were to be found amongst the girls. The evidence further went to show that the genius is balanced by the dullard more often among groups of boys than among groups of girls."

Altogether, the report is one of the most suggestive contributions that have been made to the literature on mathematical teaching in schools. We commend it most heartily to all teachers in secondary as well as elementary schools.

In the N.S.W. report there is a paragraph near the beginning which lays stress on the importance of coordination in teaching the various branches of mathematics, but it is not worked out in detail, and seems to break down in one or two places; *e.g.* in the second year trigonometry is included under arithmetic, whereas

[1] London County Council. Education Committee. Report of a Conference on the Teaching of Arithmetic in London Elementary Schools. December 1906–December 1908. Pp. 134. (London: P. S. King and Co., 1911.) Price 1s.

Memorandum on the Teaching of Elementary Mathematics. By Prof. H. S. Carslaw. Pp. 31. (Sydney, N.S.W.: Issued by the Department of Public Instruction, n.d.)

trigonometry, including the definitions and numerical work, is not begun until the third year. In arithmetic stress is laid on the importance of a grasp of principles, and reference is made to the harm text-books have done in the way of multiplying rules and setting up mere trivial examples as important types. We do not know the average age of entry to the secondary schools of N.S.W., but we doubt whether pupils in their first year are sufficiently mature in mind for such questions as "Retail and Banker's Discount" and "Balance Sheets." In England arithmetic has suffered seriously by the introduction of the technicalities of commerce and the money market at too early an age. The second-year course is to go deeper into such things; we should have thought it wiser to postpone most of this work to the third or fourth year, and bring in more numerical trigonometry and easy mechanics to take its place—it is intended to do something of the sort in the second year as "simple problems on the lever, wheel and axle, and inclined plane" are included, but there are no suggestions as to the practical work on which to base these problems.

The section devoted to algebra begins with a philosophical treatment of negative and fractional quantities, but it is not proposed that pupils should be taken through such a treatment "in their first steps in algebra"; but the course suggested for the first two years is what schools in England have been trying to break away from in the last decade. The whole attitude seems to be too abstract for beginners—we should have liked to see the factors of x^3+a^3, long H.C.F., and the solution of two simultaneous equations, "in which only terms of the second degree and constant terms occur," all postponed until after the second year, and indices and logarithms brought back in their place. We feel that it would have been wiser to make the early treatment much less abstract and more numerical, and to let the fourth-year course include a more scientific treatment of the elements of the subject.

Differential calculus is introduced into the fourth year's algebra, but seems to be intended only for those who matriculate in higher mathematics. We should like to see a short introduction to both differential and integral calculus introduced into secondary schools for all pupils of average ability. The treatment suggested in this report for the differential is good, including, as it does, the principles of the subject without elaborating the technique—we suspect that integral calculus is meant to be included as reference is made to the evaluation of areas, &c.

The report goes on to discuss geometry:—

"It is common knowledge that within the last few years the methods adopted in the teaching of geometry have been greatly altered. No less common is the belief that many of the changes which have been made have hardly justified themselves, that the relative importance of the various parts of the subject has been frequently forgotten, that much unsatisfactory reasoning is being accepted as logical, and that much unnecessary confusion exists. . . . A boy who has made a comparatively close acquaintance with straight lines, angles, circles, triangles, parallelograms, &c., by actual drawing and measurement, knows far more of their properties than one who has learnt by heart long lists of definitions and some of Euclid's propositions. And when, by a carefully graduated series of experiments and drawings, he has discovered for himself the fundamental theorems regarding congruent triangles, the theory of parallels, the measurement of areas, and the circle, he is ready to proceed to the study of deductive geometry, and should profit by that study in many different ways.

"This is the first, and one of the most important, of the changes which have been made in the teaching of geometry; but, with regard to it, some words of warning are still necessary. There is no doubt that the *rôle* of experiment, careful drawing, exact measurement, and calculation from the figures drawn by the pupils has been exaggerated."

With all this we agree most heartily, but with Prof. Carslaw's remedy we cannot agree; this practically amounts to taking the theorems of Euclid to the end of parallels, and setting them up as a standard order to be followed by all schools. Prof. Carslaw seems to feel that such a retrograde step is likely to meet with opposition, for he says: "Without prescribing rigid adherence to the scheme drawn up and embodied in its programme, the Department intends to base its instruction upon it." This seems to give the teacher the choice the famous Hobson gave to his customers when they came to hire horses. We can only express our deep regret that such a retrograde step should be deemed necessary in N.S.W. to remedy an evil which is doubtless the same in all its features as that we are experiencing in England.

The evil may be considered to be due to two distinct causes: (i) some teachers have not shown a proper appreciation of what constitutes a sound logical proof, and have let their pupils use slipshod arguments; (ii) pupils have a break in their careers when they pass from the elementary to the secondary schools. With regard to (i) it may be pointed out that practically all teachers, both in England and Australia, have had their training in geometry under a cast-iron system, viz. that of Euclid; some teachers under that system have acquired a splendid appreciation of what is logical, but the very existence of the evil referred to proves that other teachers have not acquired that appreciation—this does not point to finding the remedy in another cast-iron system, particularly one closely following the lines of Euclid.

Doubtless a rigid system would remedy the difficulty of transition from school to school, but that difficulty ought never to exist; for, as Prof. Carslaw points out, the only trouble due to the lack of a standard order lies in the fundamental theorems about congruence, and parallels and the angle-sum for a triangle; and that part of geometry, in our opinion, should not be treated deductively before the age of fourteen with any but pupils of very exceptional mathematical ability, and possibly not with them. It will be remembered that a couple of years ago the Board of Education published a circular recommending that these fundamental theorems be arrived at by induction, and then taken as a base on which to build up a logical system of deductive geometry. Prof. Carslaw says:—

"With this advice I find myself unable to agree. One of my reasons for disagreeing with their method is that I am sure the difficulty that these fundamental congruence theorems offer to the pupil is exaggerated, and that I believe the reasoning, by means of which they are to be proved, can be of value to him. Another ground for my dissent from the plan of that circular is that the treatment of parallels which it recommends, by its introduction of the idea of direction as fundamental, and by making the angle-sum theorem independent of the theory of parallels, includes one of those fallacies with which the long history of that theory is crowded."

We wonder whether Prof. Carslaw has seen the advice of the Board carefully followed by sympathetic teachers; it is generally found that the results of teaching on these lines are much better than those where a deductive treatment of congruence, &c., is attempted—there is greater knowledge of geometry, greater appreciation of logical geometry, and more power to tackle new work. We must differ from Prof. Carslaw when he says the difficulty of the congruence theorems is exaggerated—in a comparatively wide experience of boys, we have never found the proofs of these theorems clearly understood until the boy has

had some further acquaintance with deductive geometry in the form of riders and later propositions, though in many cases the proofs have been learnt for purposes of reproduction.

Again, Prof. Carslaw objects to the use of the idea of direction in dealing with parallels and the angle-sum theorem—we should quite agree with him that such a treatment would not be satisfactory in a deductive course, but we differ most strongly from him in thinking that a deductive treatment of parallels, &c., is necessary or wise in the first two years of geometry. The fact is, deductive geometry is not a suitable study for children before the age of twelve, and even at that age it must be a difficult study, and the deductive treatment of congruence and parallels is one of the most difficult parts of the subject, and should certainly not precede the deductive treatment of the parallelogram and the circle. We can only regret that New South Wales has been frightened by difficulties which were bound to arise in a period of transition, into going back to the old methods instead of boldly remedying the evil by helping all teachers to get the spirit of the new methods.

The report goes on to consider trigonometry and mechanics, but there is nothing that calls for serious comment. R. Y. S.

TSETSE-FLIES AND SLEEPING SICKNESS.

A DEPUTATION representing eight missionary societies at work in Nyasaland waited upon the Secretary of State for the Colonies on November 23 in order to urge that game restrictions should be removed over a whole or part of the protectorate, on the ground that the tsetse-fly was suspected of spreading sleeping sickness, and that the destruction of big game "might" eliminate the fly. In his reply, Mr. Harcourt very wisely deprecated hasty action in a matter in which "the best-informed people were the least positive as to the facts."

It is by no means certain that the destruction of the larger mammalian fauna would have any such effect as the members of the deputation seem to anticipate. In the first place, it is highly probable that the primary host of the trypanosome of sleeping sickness is man, and that if the trypanosome is now to be found in wild mammals in regions in which the disease is known to have been introduced in recent times, it is because it has been transmitted to them from human beings by the agency of the tsetse-flies. Secondly, it is very far from certain that the destruction of the larger mammalia would have the effect of eliminating tsetse-flies, which can suck the blood of any kind of vertebrate animal, and which swarm in parts of the Uganda Protectorate (for example, on small uninhabited islands in the Victoria Nyanza) where there are no larger mammalia. Thirdly, the danger must be reckoned with that to deprive the tsetses of a large portion of their natural food-supply might have the effect of forcing them to supplement the deficiency elsewhere, and might therefore render them much more aggressive towards men and domestic animals, and in this way more efficient in spreading trypanosome diseases.

Everyone with a knowledge of the complicated problems involved in the subject of the transmission of trypanosomes by tsetses will deprecate ill-considered destruction of the big game, an action which, while robbing large tracts of country of one of their most beautiful and valuable features, may very well have the effect of upsetting the balance of nature in a manner that would greatly aggravate the evils which it is desired to combat.

THE INTERNATIONAL CONFERENCE AT PARIS ON NAUTICAL ALMANACS.

ON the initiative of the Bureau des Longitudes, the directors of the various national ephemerides were invited by M. Baillaud, director of the Paris Observatory, to assemble there on Monday, October 23. The objects of the reunion were to consider what steps, if any, should be taken to extend the scope of the various ephemerides for the purposes of astronomy, and at the same time to effect economy by combined action and interchange of computations. A small number of the leading practical astronomers were also invited to represent the needs of astronomy of precision.

The first general meeting was held at the Observatory at 10 a.m., Monday, October 23. On the motion of Sir David Gill, M. Baillaud took the chair, having on his right M. Bayer, secrétaire de l'enseignement supérieure, representing M. Steeg, Ministre d'Instruction publique.

On the motion of M. Baillaud, Sir David Gill, as président d'honneur du Congrès de la Carte du Ciel, was nominated président d'honneur of the reunion, Dr. O. Backlund, imperial astronomer of Russia, vice-president, and Mr. H. Andoyer, of the Bureau of the Connaissance des Temps, together with the Comte de la Baume Pluvinel, were nominated secretaries. There were present:—Prince Roland Bonaparte (member of the Academy of Sciences); Messrs. Cowell ("Nautical Almanac," London), Fritz Cohn (Berlin), Eichelberger (Washington), Général de Azcarate (San Fernando), Boccardi (Turin), as directors of ephemerides; Messrs. Dyson (astronomer royal, Greenwich), Hough (H.M. astronomer, Cape of Good Hope), Perrine (Cordoba), André (Lyons), Picart (Bordeaux), Verschaffel (d'Abbadia), as directors of observatories; and, as representatives of the Bureau des Longitudes, MM. Bigourdan (president), Poincaré, Radau, Deslandres, Hanusse.

The meeting was opened with an admirable address by M. Baillaud, and with a cordial speech of welcome by M. Bayer on behalf of the Minister of Public Instruction. After some discussion, resolutions, recommending the adoption as soon as possible of Greenwich mean time as the argument for all predictions in nautical and astronomical ephemerides, were unanimously passed. In the afternoon of the same day the members of the congress attended by invitation the meeting of the Academy of Sciences at the institute, and in the evening were entertained at a banquet in the Observatory, at which M. Steeg, Minister of Public Instruction, was present. The toast of "The President of the French Republic" was proposed by Sir David Gill, to which an interesting and eloquent speech was made, in reply, by M. Steeg. The health of M. Baillaud was proposed by Dr. Backlund.

Further meetings of the congress were held on October 24 and 25, and at the conclusion of the meeting on October 25 a unanimous agreement on all points was reached. On Thursday, October 26, the directors of the nautical almanacs met in committee to make final cooperative arrangements and report to the general congress; their report was unanimously adopted at an afternoon meeting on the same day.

A translation of the resolutions adopted is subjoined. It is impossible to overrate the good will and cordiality which pervaded the meeting, or the kindness and hospitality of our hosts. Besides the official banquet on Monday, private dinner-parties were given by M. Andoyer on the Tuesday, by M. Baillaud on the Thursday evening, the latter followed by a reception; a luncheon and reception were also given on the Friday afternoon by Prince Roland Bonaparte, and

boxes at the theatre and Opéra were placed at the disposal of members of the congress.

The results of the congress promise to be of great interest and value, not merely by extending the scope and utility of the national ephemerides for the purposes of practical astronomy, but by the facilities which the universal adoption of Greenwich time offers for the comparison of the different lunar and planetary tables.

A probable sequence to these resolutions will be the universal adoption of Greenwich as the origin of longitudes in all future maps and hydrographic charts. The gain in simplicity and convenience will be immense.

Let us hope that England will respond to the international compliment thus paid to her by the adoption of the metric system of weights and measures.

Resolutions and Recommendations adopted by the Conference.

The conference strongly recommends that:—

(1) In all ephemerides the ecliptic coordinates of the sun should be given for Greenwich mean noon, and that the equatorial rectangular coordinates should be given for midday and midnight of Greenwich mean time.

(2) The ecliptic coordinates of the moon should be given at least for 0h. and 12h. of Greenwich mean time.

(3) The ecliptic heliocentric and geocentric coordinates of the planets should be given for 0h. or 12h. of Greenwich mean time.

(4) The ephemerides of the stars, that is to say, their correction from mean to apparent place, should be calculated for upper transit at the meridian of Greenwich.

The conference is of opinion that the adoption of the meridian of Greenwich for all ephemerides should be realised as soon as possible.

The conference is of opinion that in all catalogues and all collections of observations declinations instead of polar distances should be adopted.

The conference decides that those portions of the ephemerides which deal with the data necessary for the calculation of the perturbations of the small planets and comets shall be based on the masses of the planets adopted by Newcomb.

The conference decides that the names of stars shall be accompanied by a letter indicating their spectral type in terms of Pickering's notation. It is of opinion that these indications (so far as they have been determined) should in future be given in the list of 3064 stars to be published by the Bureau des Longitudes.

The conference decides that in future the stars in the fundamental and standard lists of Auwers, Boss, and Newcomb shall be designated by the letters A, B, N, and the Backlund-Hough stars by the letters BH.

For the prediction of occultations of stars the list of the Nautical Almanac shall be adopted.

The commission adopts the following resolutions:—

For the sake of uniformity in the calculation of parallaxes, eclipses, and occultations, the ephemerides shall adopt for the value of the compression of the earth the number 1/297·0, resulting from the final researches of Messrs. Tittmann, Hayford, and Helmert.

For like reasons, in the calculation of eclipses, the semi-diameter of the sun (Auwers) shall be retained, as already employed in all ephemerides.

The bureaux charged with the calculation of eclipses of the sun and moon and the occultations of stars shall choose in common agreement the tables and apparent diameters which they find most desirable, taking care to communicate in the most precise and complete fashion the data which they employ and the origin whence the adopted data have been derived.

The conference decides that the Connaissance des Temps shall continue to calculate the positions of the sun and of the planets from the Leverrier-Gaillot tables, but that bureau will in future compute the positions of the moon from the new tables of M. Radau, which are based upon Delaunay's theory. In the other ephemerides these calculations shall be based on the tables of Newcomb and of Hill for the sun and planets, and on Hansen's tables, with Newcomb's corrections, for the moon until such time as the latter tables shall be replaced by the new tables of Brown.

This second series of solar, planetary, and lunar calculations shall be undertaken by the Nautical Almanac Office, with the exception of the ephemeris of Mercury, for which the office of the "Berliner Jahrbuch" shall be responsible.

Relative to the Stars.

(1) The corrections from mean to apparent place of the stars BH shall be computed at the National Almanac Office, and be printed by the Observatory of Pulkowa; the same will apply to the daily corrections of the principal fundamental clock-stars, which latter shall include the lunar terms of short period.

(2) The ephemerides of such of the stars A, B, N as do not occur in the list of Auwers stars, which is published annually in the "Berliner Jahrbuch," shall be calculated and printed in the observatory at Turin.

(3) The ephemerides of the Auwers stars shall be calculated and printed by the "Berliner Jahrbuch," with the exception of the 343 stars printed within brackets; the calculation of the ephemerides of these latter shall be undertaken by L'Almanaque Nautico.

(4) The ephemerides of the pole-stars, that is to say, of all the stars situated within 10 degrees of north or south polar distance which are to be found in the provisional list of 3064 stars published by the Bureau des Longitudes, and of the other polar stars hitherto given in the ephemerides, shall be calculated from day to day by the Bureau des Longitudes, and shall contain the terms of short period, the values of which shall be separately indicated, however; for polar stars situated between 80° and 83° declination it will be sufficient to give the ephemerides for each alternate day.

The Connaissance des Temps undertakes to print all the ephemerides of the above-mentioned stars which are not given in other similar works.

The ordinary ephemerides of the stars shall be calculated to 0·001s. in R.A. so far as 60° of declination and 0·01″ in declination, not for each tenth day, but for each tenth successive culmination at the meridian of Greenwich in order to facilitate interpolation; they will be accompanied with the data necessary for the computation of the terms of short period.

The calculation of the constants of reduction shall be carried out by each bureau in their usual way with four or five decimals.

Relative to Eclipses and Occultations.

The calculation of eclipses of the sun and moon shall be made (in conformity with the rules established by the preceding resolutions) once by the American ephemeris and once by the Connaissance des Temps.

The computation of occultations shall be made in duplicate by the American ephemeris.

The predictions of eclipses and the elements of occultations shall be calculated with all possible precision.

Relative to Satellites.

(1) The calculation of new ephemerides of the four principal satellites of Jupiter and their phenomena shall be made by the Bureau des Longitudes, and be based on Sampson's new tables.

(2) The ephemerides relative to the ring and to the satellites of Saturn (with the exception of Phœbe) shall be calculated by the "Berliner Jahrbuch."

(3) The calculations of the ephemerides of the satellites of Mars, of the new satellites of Jupiter, of Phœbe, and of the satellites of Uranus and Neptune shall be made by the American ephemeris.

The ephemerides relative to physical observations of the sun, moon, planets, &c., shall be calculated by the American ephemeris, except the ephemeris of the crater Mösting A, which will continue to be published by the "Berliner Jahrbuch."

The computation and printing of the ephemerides of the small planets and variable stars shall be undertaken by the "Berliner Jahrbuch."

It is desirable that the calculations made by any one of the bureaux should be communicated to other bureaux, which have to use them at least three years in advance.

The above conventions will be put in force in such a way as to be complete in 1917.

It is understood that the above arrangements are provisional, subject to approval by the Governments concerned.

THE SOLAR PHYSICS OBSERVATORY.

WE take the following from Wednesday's *Times* (November 29):—

At the Congregation on Thursday, December 7, the following Graces will be offered to the Senate:—"That the recommendations contained in the report, dated November 13, 1911, of the Council of the Senate on the proposed transference of the Solar Physics Observatory to Cambridge—namely, (1) that the University accept the charge of the Solar Physics Observatory, subject to the conditions laid down in the letter from the President of the Board of Education; (2) that steps be taken to obtain the powers requisite for the suspension of the election to the Plumian professorship of astronomy and experimental philosophy when it next becomes vacant, for a time sufficient to enable the University, if necessary, to obtain changes in the statutes which define the title of the professorship and the duties of the professor—be approved."

The proposal to transfer the Solar Physics Observatory to Cambridge was discussed in the Senate last Thursday. The proposal was warmly welcomed by Prof. Newall, Prof. Sir George Darwin, Prof. Sir Robert Ball, and Dr. Glaisher. The arrangements for organising the work of the department and for the provision of the necessary site were fully explained.

Nothing seems to have been said about the financial arrangements necessary to secure permanence. In the report of the so-called Departmental Committee the following passage occurs:—

With a view to securing the permanence of any arrangement that may now be made, the committee desire to point out the importance of attaching the directorship of the Solar Observatory, if established at Cambridge, to a professorship which is not merely of a temporary character. The University may not be in a position, at present, to give any definite assurance that the professorship will be renewed at the expiration of the present tenure; but we consider it highly desirable that the Government should ascertain, before coming to a final decision, whether the University is willing at an early opportunity to consider favourably the establishment of a professorship of astrophysics on a permanent foundation.

The "permanence" contemplated by the Council of the Senate only becomes operative on the death or resignation of the present Plumian professor. It is taken for granted that the unpaid professorship of astrophysics will not be vacated for any cause in the interval. What is to happen during a vacancy is not stated. Is this the kind of "permanence" contemplated by the Government? Is the next vacation of the Plumian professorship, which everybody hopes will not occur for many years, the "early opportunity" referred to in the report of the committee?

NOTES.

FOLLOWING on the announcement last week of the appointment of an expert committee of investigation into the etiology, &c., of foot-and-mouth disease comes the interesting and, if it should be confirmed, important announcement of the discovery of the causal organism of this serious animal scourge. This claim has been put forward by a German bacteriologist, Dr. Siegel, in a paper read at the annual Congress of Prussian Veterinary Surgeons in Berlin. Dr. Siegel claims to have found the organism in the blood stream and in the local lesions in affected animals, to have cultivated it in artificial media, and that in experimenting with his organism it has satisfied the postulates of Koch. Moreover, he claims to be able to produce some degree of immunity to the disease. Details of this interesting paper are not yet to hand; and in the meantime the claim must be accepted with the reserve which must obviously be accorded to the statement of the discovery of an organism that has up to the present eluded vigorous and systematic research by other experts of almost all nationalities. In the meantime, the full details of experiments will be anxiously awaited; and if they warrant it, it will be one of the first duties of the British expert committee to investigate them carefully, and either to confirm or refute the claims of Dr. Siegel. Should the discovery be confirmed, it will indeed be an enormous boon to the whole agricultural world.

THE Bradshaw lecture is to be delivered at the Royal College of Surgeons on December 6 by Mr. R. Clement Lucas, who has chosen for his subject "Some Points in Heredity."

THE Paris correspondent of *The Times* reports that Prince Roland Bonaparte has placed at the disposal of the French Academy of Sciences a sum of 10,000*l.*, which is to serve as a fund in aid of those of its members who are engaged in research work.

THE superintendent of the Indian Museum informs us that Mr. J. Coggin Brown, curator of the museum of the Geological Survey of India, accompanies the Abor expedition as geologist. The botanical work is in the hands of Mr. I. H. Burkill, reporter on economic products to the Government of India, while Mr. Stanley Kemp, assistant superintendent in the Indian Museum, is in charge of both zoology and anthropology, with Mr. R. Hodgart as taxidermist and assistant.

THE ringing of birds in order to study their movements has been referred to frequently in these columns. About twenty thousand birds have been ringed by correspondents of *British Birds*, the rings bearing the name of the editor of that journal, Mr. Witherby. One of these birds, a sea snipe, or redshank, was shot recently at Wesport, County Mayo, and it was assumed to be a bird escaped from captivity in London. A report in *The Times* of November 29 says:—"The incident has caused much local interest, since nobody in Connaught has ever heard of a tame redshank. It has among seabirds the reputation of being remarkably shy." Local opinion in Connaught as to the difficulty of taming a redshank need not be disturbed. The bird referred to was probably ringed by one of Mr. Witherby's correspondents far away from London, and it is unlikely that it was ever in a cage.

LIEUT.-COLONEL EDGAR A. MEARNS, U.S.A., retired, associate zoologist of the United States National Museum, who accompanied the Smithsonian Expedition to Africa, under the direction of Colonel Theo. Roosevelt, will be attached as naturalist to the Childs Frick Abyssinian Expedition, which will sail from London shortly to make natural history collections in the Abyssinian region. It is proposed to make as complete a collection of the animals of the Abyssinian region as possible. The journey will be primarily through Abyssinia, but will extend into British East Africa as well, and cover a portion of that country north of the field gone over by Colonel Roosevelt in 1909–10. One of the most important regions to be visited is in the neighbourhood of Lake Rudolf, and along the shores of the lake itself. It is expected that the opera-

tions of the expedition will cover a period of approximately seven months. There is no question that, even with moderate success, the United States national collections will be enriched by valuable specimens.

THE annual Huxley memorial lecture in connection with the Royal Anthropological Institute was delivered by Prof. F. von Luschan on November 23. Prof. von Luschan in his address said that to study the old ethnic elements of Western Asia it seemed best first to eliminate the more recent immigrations of Albanians, Circassians, Bulgarians, Franks, and Levantines. It is easy also to eliminate the different nomadic tribes, of which the Kurds are of special importance, being originally xanthochroic, with light hair and light eyes, whilst in all the other groups dark complexion is far predominant. The final result of anthropometric investigations—about 5000 men were measured—is that all Western Asia was originally inhabited by a homogeneous melanochroic race with extremely short and high heads, and with a "Hittite" nose. About 4000 B.C. began a Semitic invasion from the south-east, probably from Arabia, and by people looking like modern Bedouins. Two thousand years later begins a second invasion, this time from the north-west, and by xanthochroous, long-headed tribes, like the modern Kurds, perhaps half savage, and in some way or other connected with the historic Harri, Amorites, and Tamehu. The modern Turks, Greeks, and Jews are all three equally built up upon these three elements—the Hittite, the Semitic, and the xanthochroous Nordic. Quite differently is it with the Armenians and the Persians, who, and still more the Druses, the Maronites, and the smaller sectarian groups of Syria and Asia Minor, represent the old Hittite element, and are little or not at all influenced by the somatic character of alien invaders.

AN extra meeting of the Chemical Society was held at Burlington House on Thursday last, November 23, when Prof. Harold B. Dixon, F.R.S., past-president, delivered a memorial lecture in honour of Pierre Eugène Marcelin Berthelot. Prof. Dixon dealt fully with the life and character of Berthelot, referring to his persistence, his feverish energy, and devotion to his work. Berthelot, a native of Paris, was born on October 25, 1827, in a flat overlooking the Rue du Mouton. From this flat he must often have been a spectator of many violent scenes enacted during the revolutions of 1830 and 1848. He was educated at the Lycée Henri IV, and in 1861 was promoted to the chair of organic chemistry at the Collège de France, a position he held until his death. Reference was made to the intimate and enduring friendship between Berthelot and Renan, to Berthelot's romantic marriage with Madame Breguet, and to the great happiness of their married life. Berthelot was in Paris in 1870 during the Siege of Paris, and gave considerable assistance to his country in the manufacture of explosives. Madame Berthelot, with her children, had to leave her husband, going first to Rouen and thence to London. In addition to his professorial duties, Berthelot took his share in the government of his country. In 1881 he was elected a Senator, and five years later became the Minister of Education. In 1895 he held for a short time the position of Foreign Minister in the Bourgeois Cabinet. From 1863 onwards honour upon honour was bestowed upon him. He became a foreign member of numerous scientific societies, including the Royal and the Chemical Societies; and in 1900 he was elected one of the forty of the Académie Française. A year later, on November 24, 1901, the savants from the universities and societies all over the world met at the Sorbonne, in Paris, to celebrate the seventy-fifth anniversary of his birthday, the President of the French Republic (M. Loubet) presiding. In 1907 came the dramatic end to his illustrious career, he and Madame Berthelot dying together on March 18. Prof. Dixon dwelt at some length on the varied researches for which Berthelot was famous, referring more particularly to his work on the alcohols, and to his investigations on the acetylides of silver and copper and to his researches on explosions.

IN *Man* for November Messrs. J. L. Todd and G. B. Wolbach describe a series of stone circles in the Gambia. The type is in many respects analogous to those of Europe, and their object, judging from the remains discovered in the course of the excavations, was sepulchral. The Mandingo, who now occupy the region in which they are found, know little about them, and refer them vaguely to some tribe which preceded them. Their builders must have possessed more knowledge of stone-working than the Mandingos of the present day, and had considerable aptitude in lifting heavy weights. If the recent speculations of Prof. Elliot Smith be accepted, though they involve serious difficulties, the inspiration for the construction of these monuments came from the Egyptian stone-workers. The present Mandingos so far venerate these circles that they make war sacrifices near, or on, one of the stones, and bury spear-heads there. The excavations disclosed remains of weapons very like those used by the tribe at present. The facts, so far as they go, indicate that they were the work of a branch of the Mediterranean race, to which similar constructions in western Europe have, with some degree of plausibility, been attributed.

IN the first part of the Journal of the Royal Anthropological Institute for the current year Dr. H. J. Dunkinfield Astley discusses the well-worn subject of the origin and interpretation of the cup and ring markings which appear on stone monuments. Dismissing the numerous theories of previous inquirers, he suggests that they constitute the "heraldry of primitive man," being used, like the Churinga of the Australian Arunta, to define the exogamous groups. Before this explanation can be accepted more than one difficulty must be cleared up. We must be certain, in the first place, that the social organisation of the Arunta at the present day is comparable with that of the people who engraved these symbols on the monuments. Secondly, Dr. Frazer finds no proof of totemism or totemic clans in the races of western Europe, and it is unsatisfactory to assume that totemism is established by the existence of these symbols. Dr. Astley's paper is learned and interesting, but we fear that the secret of these markings must still remain a mystery.

IN her lecture "On the Marriage of First Cousins" (Eugenics Laboratory Lecture Series, No. iv.; London: Dulau and Co., 1911, pp. 39, price 1s. net), Miss E. M. Elderton presents the evidence for and against this type of matrimonial alliance in a clear and interesting manner. Consanguineous marriages have been objected to, and are objected to, on the ground that they result in (1) marked decrease in fertility; (2) high infantile mortality; (3) the occurrence of deaf-mutism, insanity, albinism, hare-lip, and other deformities with greater frequency among the offspring than among the general population. The conclusions arrived at may be broadly stated as follows:—(1) there is no evidence available to indicate whether the marriages of first cousins are more often absolutely sterile than those of persons unrelated to one another, but, omitting sterile marriages, the average number of children is approximately the same in both cases; (2) the statistics collected by Mr. Arner in America, and published in the year 1908, tend to

show that among the issue of consanguineous marriages the death-rate of persons under twenty years old is considerably higher than the normal; (3) the evidence that the marriage of cousins is more likely to lead to albinism, deaf-mutism, and insanity among the offspring appears to be conclusive.

In No. 42 of Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, Major Rost and Captain Williams contribute the results of their own researches to the much discussed question of the cultivation of the leprosy bacillus. Although this organism has long been known and seen in the tissues of lepers, all attempts to grow it had until recently proved unsuccessful; and even now considerable scepticism is felt as to the identity of the bacteria isolated with the actual causal agent of the disease. The authors describe the organism which they obtained from cases of leprosy, and the effect produced on patients by vaccines prepared from it. In No. 41 of the same Scientific Memoirs Captain MacGilchrist considers, as the basis of original experimental work, the suitability of different preparations of quinine in medical practice. Attention is paid, in the main, to the solubility and absorbability of the different salts, and the various modes of administering them.

The thirtieth Bulletin of the Sleeping Sickness Bureau contains an account of the intracellular phase of the rat-trypanosome, *Trypanosoma lewisi*, in its development in the rat-flea, recently discovered by Minchin and Thomson. This phase was found in fleas from twelve to thirty-six hours after they had fed on the blood of an infected rat, and appears to represent the first stage in the developmental cycle of the trypanosome in the flea. The trypanosomes penetrate into epithelial cells of the flea's stomach, grow very large, and divide into a number of trypanosomes of normal size. The daughter trypanosomes are usually eight in number. They are formed by division of the parent body within its own periplast; the flagellum of the parent is retained and moves actively until nearly the last moment, when it disappears, and the body becomes spherical and tense, and bursts suddenly, setting free the daughter trypanosomes in the cytoplasm of the host-cell, whence they find their way out singly into the lumen of the stomach.

Certain small aurochs' skulls from the diluvial deposits of Belgium are described by Mr. R. v. d. Malsburg as a so-called new species, under the name of *Bos* (*urus*) *minutus*, in Bull. Internat. Ac. Cracovie, 1911, No. 5. Unless, however, the term *urus* be used in a generic sense, it would seem that a subspecies is intended. Under various forms, the author considers this *Bos minutus* to be the connecting link between the typical aurochs (which is regarded as the descendant of the Indian *B. namadicus*) and modern cattle.

We have to acknowledge the receipt of a copy of a catalogue of the exhibits in the British section of the International Shooting and Field Sports Exhibition, held at Vienna last year. The British section, it will be remembered, was in the hands of the Government, and the catalogue is therefore issued—after the usual delay—by the official publisher. The book is well got up and well illustrated, and the section on big game—which forms the bulk—will possess a permanent value as the first attempt (unfortunately incomplete) at a list of the big-game fauna of the British Empire.

In the Annals of the Transvaal Museum for July, 1911, Mr. J. Hewitt produces evidence to show that the maxillary bone of the viperine skull is more probably derived from the corresponding element of the proteroglyphous than of the opisthoglyphous section of colubrine snakes; in other words, that the Proteroglypha, rather than the Opisthoglypha (to which that position is assigned in the British Museum Catalogue of Snakes), have the stronger claim to be regarded as the ancestral stock of the vipers. The evidence derived from snake-venom seems to lend support to this view. In a second article (in Dutch), Dr. E. C. N. Hoepen describes a new generic and specific type of stegocephalian from the presumably Permian strata of Senekal, Orange River Colony, under the name of *Myriodon senekalensis*.

To *Naturwissenschaftliche Wochenschrift* for November 5 Dr. Otto Wilckens contributes an article on the extinction of animal groups during geological history, in which special attention is directed to ammonites, dinosaurs, and trilobites. Whether these groups—like the ammonites at the close of the Cretaceous—became completely wiped out by some general cause (*e.g.* over-specialisation), or whether, as Dr. Steinmann believes, they developed into new forms, is a question which is argued at some length. In the case of the ammonites the author is apparently inclined to favour the view that they may have become modified into Argonauta and the other octopods, although he rejects Steinmann's theory that dinosaurs developed into great flightless birds, that were exterminated by men, or that the "enaliosaurians" gave rise to whales and dolphins and pterodactyles to bats.

To *The American Naturalist* for November Mr. H. A. Allard contributes the second part of his account of the behaviour of bees when visiting the blossoms of cotton-plants. These bees were, of course, usually in the habit of visiting the ordinary American cottons, the flowers of these being furnished with certain nectaries which are absent in Asiatic cottons. When the insects came to fields where American and Asiatic cottons were growing side by side, they visited both indiscriminately, but when they alighted on Asiatic flowers they quickly perceived their error, and departed. "These visits of the bees to the outer basal portion of the Asiatic cotton-blossoms indicate that the visual powers alone were employed throughout the process." On the other hand, it is considered probable that bees ascertain the whereabouts of cotton fields by their sense of smell, a large area of cotton in flower giving off a distinct odour on a fine day.

The Tertiary giraffes of India form the subject of a monograph by Mr. Guy Pilgrim, published in the *Palaeontologia Indica* (new series, vol. iv., No. 1). Years ago Mr. Lydekker, in face of the opposition of the late Prof. Rütimeyer, asserted that Sivatherium and its allies were undoubtedly giraffoids. Now that his views are definitely accepted, the list of Siwalik representatives of the group is a long one; and Mr. Pilgrim has done well in bringing the available information up to date. Following the modern fashion, he divides the Siwalik species into brachycephalic and dolichocephalic types; and he has likewise been enabled to throw considerable light on the respective geological horizons of the various forms. The most generalised Siwalik representatives of the group are described by the author under the name Progiraffa, but as one of them was, for a time, called Propalæomeryx by Mr. Lydekker, the latter designation is clearly entitled to stand. Whether it be in error or by design that some of the lower jaws are figured with the teeth pointing downwards, the effect is decidedly bad.

The identification of the mosses collected on the Scottish Antarctic expedition having been entrusted to M. Jules Cardot, his report, received in separate form, is published

in the Transactions of the Royal Society of Edinburgh (vol. xlviii., part i.). The chief collection, from Gough Island, yielded twenty-one species, of which eleven are endemic; the solitary bog moss, *Shagnum scotiae*, is a new species, but represented also on the island of Ascension. Only two of the species are recorded from Tristan d'Acunha, and, although more common species may be expected, the author finds a closer affinity with the moss vegetation of the Magellan region. The new species from Gough Island and Ascension are described and illustrated.

THE October number of *Tropical Life* contains instructive articles on various economic products. In connection with the cultivation of the coco-nut palm, attention is directed to the fine grade of coco-nuts shipped from San San Blas, on the Panama coast, to the New York market, and to a cultivator suitable for removing strong-growing weeds from plantations. A discussion of the value of Nipa palms for the production of sugar and alcohol is based on the recommendations of Dr. H. D. Gibbs, of Manila, who affirms that an area of 100 hectares would supply sufficient raw material to keep a sugar-mill in continuous operation. Statistics relative to soya-bean cultivation in Portuguese East Africa are quoted, according to which a harvest varying from 25 to 40 bushels of seed per acre is obtainable; the yield of oil averages about 17 per cent. of the seed.

A *résumé* of recent researches into the nature of "graft-hybrids," culminating in the periclinal and sectorial chimæras obtained by Prof. H. Winkler and E. Heuer, is contributed by Dr. H. Fischer to *Naturwissenschaftliche Wochenschrift* (September 24). A description is given of the five composite types produced from grafts of the tomato and common nightshade by making an incision and so developing a new shoot from the point of union of scion and stock; and an illustration is supplied of the most complex combination, where the different branches represent the species *nigrum*, *Lycopersicum*, *Koelreuterianum*, *Gaertnerianum*, and *tubingense*. It is also explained how the solution was evolved by Dr. E. Baur from a study of the arrangement of coloured and colourless areas in the leaves of zonal pelargoniums. In both phenomena there is a mere juxtaposition of tissues derived from two original types, so that the term "graft-hybrid" proves to be a misnomer, and chimæra is accurately applied.

PROF. TITO ALIPPI has recently made a further contribution to our knowledge of the mysterious sounds known in different parts of the world as mist-poeffeurs, marinas, Barisâl guns, &c., and for which he proposes the name of *brontides* (*Boll. della Soc. Sismol. Ital.*, vol. xv., pp. 65–77). The new observations which he has collected come chiefly from the district surrounding Urbino and Rimini, in the north-east of Italy. The phenomena observed in this district follow the same laws as in other parts of Italy. They are well known in some localities and almost unknown in others not far distant. The detonations are usually described as resembling peals of thunder. They are heard most frequently in summer, with a clear sky and calm air, and generally occur in groups, and seem to come from the south-west. They do not appear to have any relation with local earthquakes, and are generally regarded by their observers as presaging bad weather, and especially snow in winter. From inquiries made elsewhere, Prof. Alippi concludes that brontides are practically absent from Sardinia and are almost quite unknown in all the western Alps.

So long as the bench-marks of the levelling system of this country are indicated by so crude a mark as the broad-arrow chiselled in masonry, or even cut upon wood, they do not respond to the needs of modern precise levelling, and small changes in such marks are not to be accurately determined. But in view of the probable relevelling of the main lines, and the employment of hemispherical-headed bolts for the principal points, the experience of the stability of bench-marks at Hamburg is of interest. There during the last twenty-five years the precise levelling has been checked from time to time, and a record of the changes in level of bench-marks has been kept, the results of which are given in the *Zeitschrift für Vermessungswesen* of March 11. The bench-marks are partly on high, dry ground, and partly on moist ground which is more or less affected by the rise and fall of the tide; they are also classed as on buildings, on bridges, walls, and such masonry constructions, or on stone pillars founded on a concrete block. Of the 315 marks on the dry ground, of which 301 were on buildings, 76 have shown no settlement in twenty-five years, 118 have settled from 1 to 5 mm., 68 from 6 to 10 mm., and 53 from 1 to 4 cm. In moist ground, where 399 out of 552 marks were on buildings, 291 had settled more than 1 cm., the maximum case being 21 cm.; and of these 243 were on buildings, so that under such conditions marks on separate masonry pillars or small masonry works were less affected.

THE U.S. Weather Bureau has sent us copies of its meteorological charts of the great oceans for December. In addition to the usual data which occupy the face of the charts, the reverse sides include articles on the average air and sea temperatures for that month, illustrated by special charts. Prof. McAdie supplies some interesting details relating to the steps taken for obtaining wireless telegrams from vessels in the North Pacific, and for supplying vessels with a synopsis of weather conditions and forecasts. Cablegrams are received from Honolulu, Manila, Shanghai, and Nemuro (Japan), and, through the courtesy of the "Western Wireless Press Association," wireless messages will be sent broadcast from San Francisco daily for the benefit of vessels on the Pacific. Thus what has been accomplished on the Atlantic, as regards radio-telegraphy, seems likely to be realised shortly on the Pacific also.

AN important investigation by Dr. Hugo Karsten relating to the state of the ice in the Gulf of Finland and the northern part of the Baltic forms the sixth part of *Finnländische hydrographisch-biologische Untersuchungen*. It comprises observations made during the winters of 1897–1902, with ice-charts for each year, showing by different tints the conditions at three or four different times during the season. The state of the ice naturally differs considerably in time and space in different years, but at present there is no general and theoretical discussion of the data. This is promised with the next volume, which is to appear shortly, and will, we feel sure, be a very useful addition to our knowledge of oceanography.

IN further support of his theory of the existence in the electric discharge through vacuum tubes of "magnetic rays" made up of doublets formed by the combination of a negative electron with a positive ion, Prof. Righi describes two new experiments in the *Rendiconti* of the Academy Lincei, part iv., and in *Le Radium* for October. The first consists in bringing a bulb, in which an electrodeless discharge is being produced by an oscillating discharge through a flat coil outside it, into the magnetic field of a coil through which a direct current is flowing. The luminous ring stretches out towards the coil and becomes bell-shaped. In the second experiment canal rays are produced behind a kathode of considerable thickness placed obliquely to the axis of the tube and pierced by a small

hole at right angles to its surfaces. The canal rays are received on a plate which is connected to a galvanometer. When a magnetic field parallel to the axis of the tube is established, the "magnetic rays" produced fall on a second plate, which can also be connected to the galvanometer. This plate is found to receive no current whatever from the magnetic field, but the first plate receives a positive current, which decreases as the magnetic field increases.

IN laboratories remote from large towns, the absence of a gas supply is the cause of much difficulty; and this applies to chemical, physical, bacteriological, agricultural, and metallurgical laboratory work. Carburetted water gas has been used in some cases, but has been shown to be attended with some drawbacks. We have received a pamphlet from Messrs. Mansfield and Sons, of Birkenhead, describing their oil-gas apparatus for laboratories. For the gas plant great durability and simplicity is claimed. Any kind of oil (mineral, animal, or vegetable) can be used for cracking, and no skilled labour is necessary, since putting a shovelful of coal on the fire every twenty or thirty minutes, and seeing that the oil is flowing in, is all the attendance required. The oil gas produced is permanent, has a very high calorific value, and requires no purification before use. This gas can be used in ordinary burners and appliances for laboratory use, provided that the gas jet is reduced in size to correspond with the higher carbon contents of the gas. Particulars are given in the same list of Bunsen burners, furnaces, drying and sterilising ovens, blow-pipes, and water heaters modified to burn oil gas.

THE memorandum of the Manchester Steam Users' Association for the year 1910 contains some interesting investigations by their chief engineer, Mr. C. E. Stromeyer, on the trustworthiness of mild steel. Some of the results have been presented at the Iron and Steel Institute; and in the present paper Mr. Stromeyer gives subsequent data confirming the view that the presence of nitrogen gives a bad steel likely to crack in undergoing the necessary workshop processes or in subsequent working of the boiler of which it forms a part. The evidence points to the fact that steels in which the percentage of phosphorus added to five times the percentage of nitrogen exceeds 0·08 will be untrustworthy in working. The author has tried many mechanical tests with the view of discovering one which would differentiate between trustworthy and untrustworthy steels, but without success. Except as regards bad heat treatment, chemical determinations, more particularly of phosphorus and nitrogen, are the only available guides when the process of manufacture and the composition of the raw material are not known. Engineers, however, are not likely to place overmuch confidence in a test which they cannot check, and will prefer to continue to rely on the reputations of the manufacturers, combined with a few mechanical tests.

THE third part of the work known as "Harmsworth Popular Science," edited by Mr. Arthur Mee, which is appearing in fortnightly sevenpenny volumes, has been received. In it the story of the evolution of the earth as the abode of plant and mineral life, the appearance of man and his gradual development, and his subsequent conquest of nature and the organisation of human society, is continued in the same popular manner as in previous issues. The work is profusely and excellently illustrated, and the account it provides of the triumphs of science will serve to encourage among ordinary readers an appreciation of the extent to which human progress is indebted to the labours of men of science.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR DECEMBER:—

Dec. 3. 19h. 39m. Saturn in conjunction with the Moon (Saturn 4° 5′ S.).
4. 15h. 55m. Mars in conjunction with the Moon (Mars 0° 50′ S.).
6. 22h. 0m. Mercury in conjunction with Lambda Sagittarii (Mercury 0° 1′ S.).
7. 7h. 0m. Mercury at greatest elongation E. of the Sun.
10. 23h. 0m. Vesta in conjunction with the Moon (Vesta 0° 28′ S.).
15. 15h. 0m. Mercury stationary.
16. 2h. 58m. Venus in conjunction with the Moon (Venus 3° 39′ N.).
22. 10h. 54m. Sun enters sign of Capricorn. Solstice.
" 14h. 43m. Uranus in conjunction with the Moon (Uranus 4° 36′ N.).
25. 4h. 0m. Mercury in inferior conjunction with the Sun.
29. 9h. 0m. Mars stationary.
31. 3h. 59m. Saturn in conjunction with the Moon (Saturn 4° 1′ S.).
" 20h. 10m. Mars in conjunction with the Moon (Mars 0° 1′ S.).

OBSERVATIONS OF MARS.—Nos. 4537–8 of the *Astronomische Nachrichten* contain several important records of recent observations of Mars. Under date November 21 Prof. Lowell telegraphs: "First morning frost Mars observed since November 3, 30° from S. pole on sunrise limb."

M. Antoniadi reports an encroachment of Syrtis Major, since 1909, on the W.S.W. of Libya to the extent of about 100 km., and several other changes. The chief interest of the observations appears to be in the apparent variations wrought by changes in the Martian atmosphere. M. Antoniadi suggests that, with these eliminated, the actual changes in the majority of the small details of the planet's surface would be very few. The intrinsic colour of such "*îles*" as Argyre 1, Noachis and Hellas, it is deduced, is red, and their apparent bronze hues are produced by the passage of yellow cloud screens.

M. Comas Sola records observations made at the Fabra Observatory, Barcelona, during October 9–16. A new canal was seen on October 9 to the east of Syrtis Major; it appeared to correspond to a prolongation of Nubis, which, passing L. Mœris, extended as an arc towards Triton. The whole region of Isis and Libya was covered by an immense, oval, brilliant cloud on October 11, the new canal being completely hidden in parts; this veil afterwards moved away at about 30 km. per hour. M. Comas Sola tentatively suggests that volcanic action on Mars would account for the production of these massive veiling clouds.

Important changes are also reported by the Jarry-Desloges observatories at Massegros and Sétif. Nepenthes and Nilosyrtis are said to be enormous, and Ausonia and Hesperia greatly changed; early in November the diameter of the south polar spot was 1·2″.

ARE THE WHITE NEBULÆ GALAXIES?—This question is attacked from several directions by Prof. F. W. Very in No. 4536 of the *Astronomische Nachrichten*, and the discussion of the various points is exceedingly interesting. Considering the relative brightness of nebulæ of different diameters, he arrives, first, at the conclusion that the light from these extra-galactic bodies does suffer absorption in interstellar space, and therefore one of the great objections to an infinitely extended universe, the apparent darkness of the sky, is explained. Then the apparent sizes and brightnesses of these bodies are compared with those of other celestial bodies of which the distances are approximately known. This leads to results as to the intrinsic brightness of the white nebulæ, hence to the question of their star-density, and, finally, it is found that these celestial objects are probably galaxies. Their diameters appear to differ to at least a fourfold extent, and the dimensions and brightness of the component stars are closely allied to those obtaining in our own stellar system. Of course many assumptions are necessary in such a discussion; but it is

interesting to note that Prof. Very deduces for the chief object of this class, the Andromeda nebula, a distance of about 1600 light-years, and suggests that the faintest and smallest of the white nebulæ may represent galaxies at a distance of one million light-years.

METEOR STUDIES.—All meteor observers would find Dr. C. P. Olivier's thesis, based on the study of more than 6200 meteors, of great interest. The determination of orbits was the primary motive, and 175 parabolic orbits have been deduced; but the other results would probably interest the average observer more. For example, the orbit of Halley's comet and that deduced for the η Aquarids are so remarkably similar that identity of origin is assured. But the size of the meteoric current is shown to be enormous, and on May 12, 1910, it was 13 million miles' radius. The evidence for stationary radiants is shown to be very weak, and the existence of such phenomena is in doubt. A special study of the so-called α-β Perseids was made, and the result indicates that they exist only in August. Duration of visibility is connected with colour, yellow meteors having the shortest, red and orange longer, and white and green meteors the longest, periods of visibility. The paper is published as an extract from the Transactions of the American Philosophical Society, N.S., vol. xxii., part i.

POPULAR OBSERVATORIES.—From time to time we have in these columns welcomed the establishment of observatories, of which the chief aim is to popularise the science of astronomy. Unfortunately, it would appear that the desire and the means to organise such institutions are greater on the Continent than here. The latest addition to the list, established at Munich, is described in No. 2007 of *La Nature*, and from the excellent illustrations it is evident that this *observatoire populaire* is well equipped. At first the organisers planned to mount the instruments on a high tower, and thus to escape some of the astronomical disabilities of an urban site; but the Commission of Architecture, which looks after the artistic amenities of Munich, decided that this project would mar the town's beauties, so the astronomers have to put up with an observatory placed at a lower altitude.

THE GREEK QUESTION AT OXFORD.

ON Tuesday, November 28, the statute providing for the exemption of candidates in the honour schools of mathematics and natural science from the necessity of offering Greek in Responsions was submitted to Convocation and rejected by a large majority, the numbers being 360 for and 595 against. The question had been thoroughly discussed by means of letters to the Press and printed fly-sheets circulated more or less widely among members of Convocation. On one side it was alleged that the modicum of Greek required in Responsions, which is practically, though not statutably, an entrance examination to the University, could be of no service to anyone who did not follow the study further, and only acted as an obstacle in the way of matters more important for the end in view. On the other side it was maintained that even a moderate acquaintance with the Greek language and literature was of value to most men; and the authority of the late Lord Kelvin was invoked in support of the opinion that this applied with especial force to those engaged in the pursuit of natural science.

An argument that was used with some force by the opponents of the statute concerned itself with the effect likely to be produced by the passing of the present proposals, followed, as they no doubt would be, by further measures of a similar nature, upon the facilities for learning Greek afforded in the smaller schools. When Greek is once made optional at the older universities, it was said, a chief inducement for the maintaining of instruction in Greek will be removed, except in the case of the great public schools, the result of which will be that many boys well capable of turning a knowledge of Greek to good account will be deprived altogether of the opportunity of learning it.

There is no doubt whatever that some of the opposition to the statute was due to the fact that many of its supporters openly avowed that they regarded it as a mere temporary compromise, to be followed in due course by more stringent limitations on compulsory Greek. This deterred many who would have voted for the statute if it had been put forward and supported as a final settlement of the question. On the other hand it is at least highly probable that many supporters of the statute disliked its provisions, but voted for it because they knew that it would not dispose of existing difficulties, and that it might be replaced in course of time by something more to their mind.

Much interest was aroused over the question as to how far a body like Convocation, which is largely non-resident, could legitimately be appealed to against the decision of what was presumably a majority of resident teachers. On one hand it was held that Congregation, the members of which are resident and to a great extent engaged in the actual teaching and examining work of the University, must be best qualified to judge of the educational requirements of different classes of undergraduates. On the other hand it was pointed out that Convocation, consisting for the most part of men who after completing their university education had passed out into the world and joined the ranks of the various professions and public services, would be well qualified to estimate the value of the education which they themselves had received, and desired by them for their own sons. A matter of broad educational policy, it was maintained, might properly come within the purview of the latter body, while questions of detail should be left in the hands of the resident teachers. In addition to this it was pointed out that the majority by which the measure passed Congregation was very far indeed from being a majority of the whole body, less than half of the members of Congregation having actually recorded their votes on that occasion.

Notwithstanding the figures of last Tuesday's division, it would be a mistake to suppose that any considerable number of people are entirely satisfied with the present system of entrance examination. There is little doubt that the question of reform will again be mooted; and it may be hoped that some plan may be devised, perhaps on the lines of a "leaving certificate" to be gained at school, which will secure a reasonable amount of support from all parties.

PAPERS ON INVERTEBRATES.

AMONG a number of papers relating to invertebrates which have recently come to hand, the following are selected for notice:—

Bulletin No. 16 of the Connecticut Geological and Natural History Survey is devoted to the first two parts of a guide to the insects of that State, prepared under the direction of Dr. W. E. Britton. Part i., comprising a general introduction, is by the editor, while in the second part Mr. B. H. Walden treats the Euplexoptera and Orthoptera. Special attention is directed to the economic aspects of the subject.

The British spiders usually included in the heterogeneous group Tmeticus and certain allied genera form the subject of an article by the Rev. J. E. Hall in the third part of vol. iii. (new series)) of the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle. It is now shown that the group is divisible into sections, one represented by Centromerus, in which there are only three outer falcal teeth, and the other by several genera (some of which are named for the first time) in which there are four or five of these teeth.

In a note on the Crustacea obtained during the trawling expedition fitted out by the New Zealand Government in 1907, Dr. C. Chilton (Records Canterbury Museum, vol. i., No. 3) states that the shell of a crab of the genus Paramithrax seems to be almost invariably infested by barnacles (*Balanus decorus*), which are in some cases so numerous and so large as to exceed the crab in bulk. A hermit-crab (*Eupagurus stewarti*) was found in some cases inhabiting a massive polyzoon apparently too big for the crab to move; in other cases it sheltered in straight tubes in a Millepora, these tubes, it is suggested, perhaps having been originally formed round sea-weeds, which subsequently rotted.

To the same author we are indebted for copies of two papers on local crustaceans, published in vol. xliii. of the Transactions of the New Zealand Institute. In the former of these Mr. Chilton revises the New Zealand representatives of the group (Stomatopoda) typified by the familiar European *Squilla mantis*, while in the second he catalogues the crustaceans at present known from the Kermadec Islands. Despite the fact that the crustacean fauna of those islands has been systematically collected, for the first time no new forms are recorded.

As the result of the examination of a collection of rotifers obtained from Clare Island, west coast of Ireland, Mr. C. F. Rousselet (Proc. R. Irish Acad., vol. xxxi., p. 50) finds that these organisms do not differ materially from those of the mainland.

On the other hand, in a paper on Irish annelids of the family Maldanidæ, Mr. I. Arwidsson (*ibid.*, vol. xxix., Sect. B, p. 209) finds himself in a position to name and describe two new species, one of which is also regarded as entitled to represent a new genus.

In Bulletin No. 71 of the U.S. National Museum is published the second part of Mr. J. A. Cushman's monograph of the Foraminifera of the North Pacific, this instalment being devoted to the primitive family Textulariidæ. Several new species and a few new genera are described. The group has been found to be of considerable interest from the distributional point of view. It is stated, for instance, that "many of the species occurring in the Indo-Pacific area extend southward to the region of Torres Strait. In the North Pacific, however, these species are, as a rule, confined to the western portion from southern Japan southward. The rediscovery of some of the species described by J. Brady, from almost the exact locality where they were dredged by the *Challenger*, is very interesting, and tends to show the restricted distribution of certain forms."

Rotifers of the bdelloid group indigenous to South Africa form the subject of an article, by Mr. J. Murray, in vol. iii., No. 1, of the Annals of the Transvaal Museum. Although the Central and North African representatives of the group had received some attention, very little was known with regard to those of the South, so that the author has been able to make considerable additions to our knowledge. The paper concludes with a summary of what is known with regard to African bdelloids generally.

In vol. viii., Nos. 4–6, of the University of California Zoological Papers Mr. C. A. Kofoid continues his account of the dinoflagellate animalcules of the San Diego area, dealing in the first two papers with the genus Gonyaulax and the morphology of its skeleton, while in the third (forming the fifth of the whole series) he describes, under the name of Spiraulax, a new generic type of the peridinid group.

The nine species of earwigs now found in the British Islands (some of which are introduced) form the subject of a coloured plate in the October number of *The Entomologist's Monthly Magazine*. According to Dr. M. Burr, nearly all these earwigs, with the exception of the common species, are rare and local. R. L.

LIPOIDS AND NUTRITION.

A WORD is perhaps necessary in explanation of the term lipoids. These are substances, contained in the outer protoplasmic layer of all cells, which resemble the fats in being soluble in organic solvents. They appear to be essential constituents, and are specially abundant in that tissue which pre-eminently manifests "vital properties," namely, the nervous tissues. The majority of them, though by no means all, contain both phosphorus and nitrogen. Very little is as yet known as to their constitution and properties.

At the present moment, when so much attention is being devoted to problems of nutrition, a communication by Prof. Stepp, of Giessen (in part v. of the *Zeitschrift für Biologie*), is of very considerable interest. The idea has been gaining ground that an ordinary diet contains certain constituents, present only in minimal quantity, the presence of which, in addition to the proper proportions of protein, carbohydrate and fat, is essential for growth and the maintenance of life. Experiments made with rice in connection with "beri-beri" have pointed to such a conclusion; and the work of Prof. F. G. Hopkins, of Cambridge, of which, so far, only a preliminary account has been given, has gone very much further in the same direction.

Prof. Stepp, who selected mice for his experiments, has studied the effect of extracting the food very completely with alcohol and ether before administration. The food used consisted of a dried mixture of rice, treated so as to be particularly rich in protein, and new milk; before extraction it was found to be a very satisfactory nutrient for mice. When fed, however, with the extracted food, the mice very soon died, showing that an essential constituent had been extracted from the food. The addition of mineral salts to the extracted food did not make it of any greater value, but the addition, on the other hand, of the evaporated extract enabled the mice to remain alive and thrive. Extraction in the manner described removes, amongst other things, fats from the diet. Accordingly, experiments were made in which butter or fats such as tripalmitin, tristearin, or triolein were added to the extracted food; in no case was the addition of the faintest value in preserving life. The essential substance is considered to be a lipoid which is absent from butter, though present in the milk plasma. In proof of this it is established that an extract of dried butter-milk when added to the extracted food is sufficient to keep the mice still in good condition at the end of six weeks. It is possible to measure the quantity of this lipoid required; and the experiments show that whereas the evaporated extract of 75 c.c. of milk per 100 grams of solid extracted food was insufficient, that from 200 c.c. of milk was more than enough to maintain health.

Certain of the lipoids have been isolated in a pure state, and their effect could be tested; it was proved that the addition of either lecithin or cholesterol to the diet was of no use. The essential substance is therefore of a very subtle character. Stepp's experiments with boiled milk are of some interest; though boiled milk by itself is of value to the animals, the alcoholic and ethereal extracts of it when added to the extracted food are unable to maintain life.

If these conclusions are substantiated, an altogether new trend will be given to work on nutrition.

WATER RESOURCES OF THE UNITED STATES.

OF the three volumes recently issued by the United States Geological Survey, that (No. 256) on "The Geology and Underground Waters of Southern Minnesota," by Messrs. Hall, Meinger and Fuller, is certainly the most interesting, and claims primary notice. It is a brochure of 406 pages, with a number of sections and diagrams and four folding maps, all descriptive of matters, physiographical, geological, and chemical, connected with water supplies in the southern two-fifths of the State of Minnesota—an area of 28,265 square miles, which is roughly about the size of Scotland or Ireland. The district contains two towns of importance, Minneapolis and St. Paul; but, apart therefrom, the whole, with its $1\frac{1}{4}$ million inhabitants, is essentially agricultural in character. The surface comprises three elevated plateaus of different levels, with trough-like depressions between, all, with the exception of the extreme south-east and south-west corners, composed of glacial drift deposited during the most recent ice invasion. "Nowhere is there a more typical example of a ground moraine left in the wake of a continental ice sheet than is exhibited by the extensive, slightly undulating, monotonous expanses of southern Minnesota, dotted with countless shallow lakes and ponds, and covered with an interminable network of swamps."

Generally speaking, the drift is yellowish at the surface to a depth of some 15 feet, where it changes to a dark colour, due, no doubt, to the presence of unoxidised iron; and the water contained in it is almost universally charged with that mineral in the soluble ferrous condition. The effect of this, and of other constituents, on the utility and value of the water for various purposes is discussed at some length, and the volume then proceeds to deal with

the subject of well-sinking, after which there is a useful series of analyses and particulars of the water obtainable in different localities.

Pamphlet No. 274, on "Some Stream Waters of the Western United States" (Herman Stabler), is almost purely statistical throughout, and gives analytical tables of the constituents of water taken from the basins of the Rivers Colorado, Columbia, Mississippi, Rio Grande, and Sacramento.

Pamphlet No. 265 deals with the "Surface Water Supply in the Basins of Hudson Bay and the Upper Mississippi." The observations are by Messrs. Follansbee, Horton and Bolster, and are akin to those already described in connection with others of the dozen districts into which the States have been mapped out for the purposes of hydrological investigation.

ROMAN SURVEYING.

IN the *Zeitschrift für Vermessungswesen* (Heft 21, 1911) Prof. E. Hammer discusses the precision with which the nations of antiquity were able to mark out lines on the surface of the earth with the means at their disposal. Taking, first, that portion of the frontier of the Roman Empire which existed as a straight line about 80 kilometres long from near the River Rems in Württemburg to the district of Wallfürn in Baden, he investigates the question whether this line was laid down approximately straight by chance, or whether it was intended to be a straight line and special care was taken to arrive at this result. Points on the line were located and their positions plotted on the cadastral maps (scale 1 : 2500), from which their coordinates were determined. From these the direction-angle of portions of the line was calculated, and also the mean departure of points on the boundary line from the true straight line. For a portion amounting to 29 km. of the whole length, the mean error in position of a point on the boundary was found to be ± 2 metres, which indicates a surprising accuracy in carrying such a line over rough ground, while for portions of it an even greater precision was attained. Further observations by Prof. Leonhard, not yet published, on the remaining 50 kilometres of the boundary indicate that the accuracy is there maintained. The Romans must have fixed a few principal points in prominent positions by signals at night, and then interpolated intermediate points; the observed accuracy could never have been attained by prolonging a line.

A second case is that of the amphitheatre at Pola, laid out by a Roman architect or land surveyor, which has been recently studied by an Austrian surveyor, Herr Hofrath A. Broch. Using a plan on a scale of 1 : 250, he investigated the accuracy with which the form of the amphitheatre as constructed approached an ellipse. Taking twelve points on the curve, their mean error in position from a true ellipse was but 15 cm., in spite of the weathered surfaces of the stone contributing to this uncertainty. The axes of this ellipse were $2a = 129 \cdot 9$ m. and $2b = 102 \cdot 6$ m., or in the ratio of very nearly 9 : 7, as in the case of many Roman amphitheatres. Prof. Hammer goes on to refer to the results obtainable in a similar way from stone circles, where it is important to determine not only their dimensions, but also their accuracy of construction. The accuracy attained at Stonehenge is referred to; and in mentioning the "Standing Stones of Stenness" he suggests that in the circle of 340 feet in diameter, formed of about 60 stones $17\frac{2}{3}$ feet apart, we may have had a circle of 60 stones exactly $(60 \times 17\frac{2}{3} = 1060)$ indicating a sexagesimal division of the circle.

THE NATURAL HISTORY OF TYNESIDE.[1]

AMONG the natural history societies of this country that of Tyneside stands out by reason of its illustrious traditions and successful enterprise. Without municipal assistance it has originated and maintained for many years a museum of high standing, and its members have contributed classical memoirs on the geology, flora, and fauna of Great Britain. The names of William Hutton, of the two Hancocks, of Joshua Alder, and of Hewitson, to mention only a few, are associated with some most careful and beautifully illustrated work. It is therefore fitting that an account of these men and of other single-minded devoted students of natural history who have worked on Tyneside should be commemorated in these Transactions as has been done in an article by Mr. Leonard Gill, the curator of the Hancock Museum. This article is the one of most general interest in the volume before us; but there are also other papers of more than local importance to which we may direct the attention of workers who are following similar lines of investigation.

The most important of these is the account of the Crustacea of Northumberland and Durham by Canon Norman and Dr. G. S. Brady. This is the most complete of any county list for this class, since the fresh-water and terrestrial forms are included in an exhaustive study that has occupied almost the lifetime of these distinguished carcinologists. Scattered through these records of 644 species are many interesting remarks; for example, the prevalence during the winter of Arctic Euphausiids, which are brought by a southward current so far down the east coast as Yorkshire: and the rediscovery of the Daphnid Leydigia, after a lapse of twenty years, in remarkable circumstances. In spite of the length of this list, two forms that might be expected to occur are not mentioned. Neither Cheirocephalus nor any Phyllopod is recorded, and Leptodora, so common in Cumberland, is apparently absent from Northumberland and Durham.

Perhaps the chief feature of these Transactions is the amount of attention that has been given to the study of obscure or neglected groups of invertebrates. In this respect the papers by Mr. Bagnall are especially worthy of mention. This indefatigable naturalist has not only dealt with the Collembola, but also with two much neglected groups of myriapods, the Pauropoda and Symphyla, and with the little-known Thysanoptera, or thrips. These papers constitute a valuable addition to our knowledge of the British Cryptozoic fauna. The arachnids, again, are energetically and successfully studied by members of this society; and several papers by Dr. Rendall Jackson and the Rev. T. E. Hull constitute not only additions to our knowledge of this section of the British fauna, but to that of the order as a whole. The careful description of that very rare Coal-measure arachnid *Anthracosiro woodwardi*, Pocock, by Mr. Leonard Gill, is a comparative study of the specimens found near Newcastle and elsewhere. Lastly, Miss M. C. Lebour's papers on the trematodes of the coast constitute a further instalment of good work on a very little known group; and there are other papers on topographical geology which we have not room to discuss. The society is to be congratulated on such a substantial output of valuable scientific work. As a suggestion, may we point out the desirability of printing the author's name as a headline on the left-hand page of these memoirs in order to facilitate references?

[1] Transactions of the Natural History Society of Northumberland, Durham, Newcastle upon-Tyne. New Series. Vol. iii., parts 1, 2, and 3. (London: Williams and Norgate, 1908–1911.)

CANCER RESEARCH.[1]

THE Fourth Scientific Report, apart from the introduction, is restricted to three papers. The first, on spontaneous cancer in mice, by Dr. Haaland, treats of a large number of additional spontaneous tumours of the mouse since the Third Scientific Report was prepared. These tumours consist of carcinomata and sarcomata occurring in a variety of sites other than the mamma, and are considered from clinical, pathological, histological, and experimental points of view. The animals in which they were found have been submitted to a number of experimental tests in order to elucidate the relation between a tumour and the animal in which it arises. The second paper, on cancerous ancestry and cancer in mice, by Dr. Murray, deals with breeding experiments bearing upon heredity, which have been in progress for some six years with mice of known ancestry, and from which a large number of the tumours and mice studied in the first paper have been obtained. The third paper, on the behaviour of tumour-cells during propagation, is a general survey of the

[1] From the introduction to the Fourth Scientific Report on the Investigations of the Imperial Cancer Research Fund. By Dr. E. F. Bashford. Pp. xxi+223. (London: Taylor and Francis, 1911.)

observations made on all the tumours observed or propagated in the laboratory during the past eight years, and of the bearing of their relative constancy and variability upon the nature of some forms of cancer.

All three papers are intimately interdependent as regards the material upon which they are based, and they overlap in so far as each treats more especially of particular problems not excluded from consideration in the other two. Thus, as in all previous reports, the effort is made to co-ordinate the features of cancer as it occurs naturally with its behaviour under experimental conditions.

New facts are brought forward in support of the view that a malignant new growth arises from local causes in a circumscribed area, and that the relation of each malignant new growth to the affected animal is an individual one, parallel to that obtaining between the organs of the body and the organism as a whole.

Precise evidence is advanced of the existence of hereditary predisposition to the development of spontaneous cancer. It is apparently of the nature of a predisposition of certain tissues to pass into cancerous proliferation, and is not effective by determining an increased suitability of the animals primarily affected for the growth of cancer as tested by transplantation.

Tumour-cells derived from a single primary growth are shown to be liable during extended propagation to variations such as are met with, either singly or in combination, in other primary growths. It is assumed that this demonstration permits of the inference that corresponding variations occurring in the course of the prolonged proliferation of normal cells under the influence of chronic irritation may be responsible for the development of some forms of cancer.

The relations between benign and malignant new growths, and of both to normal tissue, have been studied both histologically and experimentally on an extensive material. Among the large number of tumour-strains that have been propagated by *passage* from one batch of mice to another for extended periods, there are included several reproducing very closely the features of normal tissue, either as regards its histology or its limited[2] power of growth in any one animal after homologous transplantation. Some tumour-strains, while retaining almost perfect histological differentiation, grow progressively in any one animal; while others, notwithstanding that they are quite devoid of histological differentiation, possess only a limited power of growth in any one animal. The gaps between the structure of normal tissue and the least differentiated tumours, on the one hand, and between the growth of normal tissue, when transplanted, and that of even the most rapidly proliferating tumours on the other, have been filled in by a continuous series of tumour-strains. Some of these approximate to normal tissue both in respect of structure and of power of growth on transplantation, and experiment has brought out still more clearly the pure arbitrariness of the conception of a fundamental difference between benign and malignant new growths.

The demonstration that cancer occurred in practically all races of mankind and throughout the vertebrates even when living in a state of nature, together with the demonstration of the only manner in which cancer can be transferred from one individual to another of the same species, viz. by implanting living cells, proved that it was not due to a common causal parasite. The wide zoological distribution of the disease, down to marine fishes, showed that it was not a recent acquirement such as might be referred to influences dependent on man's particular forms of civilisation. As has been frequently pointed out, the age-incidence of cancer in man and animals is, in the absence of communicability, compatible only with the recognition of the intrinsic cellular nature of cancerous proliferation.

The parallel behaviour of normal and cancer tissue, both as regards the absence of continued growth and the nature of the cytotoxic reactions induced when cancer is transferred from one animal to another of a strange species, proved that cancer had all the properties distinguishing the normal tissues of one species from those of another species.

[2] In spite of being possessed of a power of only limited growth in any one animal, tumours can be maintained in extended propagation by suitably accelerating the rapidity of *passage*. This has not yet been accomplished in the case of normal tissues.

The fact that transplantable tumours grow in normal animals as well as they do in spontaneously affected animals is evidence that the latter do not present a soil for the growth of cancer substantially different from that presented by normal animals. When this fact is contrasted with the almost invariable success of reimplanting into the animal a portion of its own spontaneous tumour, and the almost invariable failure of implantation of any spontaneous tumour into other spontaneously affected animals, the conclusion is arrived at that each tumour is peculiarly and genetically related to the individual in which it arises.

This conclusion, drawn from studying the growth of tumours under the different conditions just enumerated, is supported by the results of elaborate experiments on inducing resistance or immunity to the inoculation of cancer-cells under these different conditions. The features of resistance bearing upon the nature of cancer are briefly as follows. Resistance is induced only by the living cells, either cancerous or normal, of the same species. Under similar conditions the cancerous cells and the normal cells of strange species are both devoid of the power to induce resistance. An animal's own tumour and its own normal tissue are devoid of this power, and the means which prevent the successful inoculation of the tumour of another individual do not prevent the successful inoculation of an animal's own tumour. Tumour-tissue usually induces resistance against itself quite as well as, and, with regard to the phenomenon of spontaneous healing, much more effectively than, any other tumour. Furthermore, animals which have proved resistant to the repeated inoculation of a tumour have subsequently developed spontaneous tumours showing progressive growth. Thus experimental inquiries into the production of growth by inoculation, on the one hand, and its prevention on the other, agree in demonstrating individual relations as obtaining between a tumour and the animal in which it arises. The individuality of tumour-cells will be referred to later.

The individuality of cancer, both as regards the organism attacked and the tumour, would thus appear to have been placed at last beyond all further doubt. Such a relationship has long been maintained in various forms on the basis of deductions drawn from histological examination of the tissues at the site of the primary lesion and from the nature of dissemination; but this interpretation of the findings has been as vehemently combated. The combination of the results arrived at by microscopical investigation and experimental study appears to complete the demonstration. A long step has thus been taken in defining the direction in which the future investigation of cancer is alone likely to be profitable.

The conclusions as to the individuality of cancer are supported also by most important new statistical information given in the last report of the Registrar-General.[3] The new tabulation of the data for the years 1901–9 for England and Wales has permitted of an analysis being made of the figures recording the increase of deaths attributed to cancer, which brings out the fact that the increase during this period is referable to certain anatomical regions and not to others. For the first time it is fully demonstrated that it is erroneous to make statements of a disquieting nature about the increase of cancer in general. The analysis also shows that the incidence is very unequally distributed among the several situations, indeed, that the whole curve of incidence may be different for different organs. A progressive increase up to the highest age-periods is characteristic of the face, lip, mouth, bladder, urethra, and breast only. The other organs show a distinct diminution in the highest age-periods; but it is not yet possible to determine whether this curve indicates a liability rising to a maximum and followed by a fall, or is merely the result of ascribing deaths to other causes in the case of cancer of internal organs in aged people. Sufficient has been said to indicate how important are the problems which are solved or revealed by the improvement in the details given in the national statistics.

The study of the occurrence of cancer in mankind, and in domesticated animals in widely separated parts of the globe, has shown that the practice of peculiar customs (involving

[3] Seventy-Second Annual Report of the Registrar General of Births, Deaths, and Marriages in England and Wales (1909). (His Majesty's Stationery Office, 1911.)

the application of chronic irritants to particular parts of the body) provokes the disease in situations and organs from which it is absent when these customs do not obtain. It is reasonable to suppose that the frequency of cancer would be diminished if such practices as the use of the Kangri in Kashmir, chewing betel-nut in India, and eating very hot rice in China were discontinued. It is also reasonable to assume that the introduction into England of these exotic customs would greatly increase the frequency of cancer in this country.

So definite is the evidence of the *mediate* causation of certain forms of cancer by chronic irritants that the possibility of variations in the cancer death-rate may be admitted as regards particular organs and regions of the body. The possibility of a variation of the main incidence of cancer in conformity with changes in certain customs may also be admitted.

That irritation is really an important causative factor of cancer is an assumption which at present is justifiable only for certain forms of cancer occurring in particular parts of the body. In view of these considerations, and also because of the results of experiment as recorded in this report, it appeared desirable to have data of the incidence of cancer in persons pursuing various occupations and having different habits of life. For the purposes of comparison it will be necessary to learn not only the incidence of cancer on particular sites liable to irritation, but also its incidence on all other sites, as well as the frequency of the other causes of death in the occupations considered.

Breeding experiments with mice of known ancestry have been in progress for many years, and have been alluded to on several previous occasions, but only now have the data become sufficiently numerous to permit of conclusions being drawn. All due precautions have been taken to avoid errors in the interpretation of the figures. The data show that heredity plays a part in affecting the liability of the mouse mamma to develop cancer. At all age-periods the disease is more frequent when the mother, or either grandmother, or all three, have died from cancer of this organ than in the group in which these ancestors were free from the disease.

Apart from its bearing upon heredity, the obtaining of such mice is most important for furthering the experimental investigation of the genesis, nature, and, should it be necessary, artificial production of cancer, and for attempting to define the reasons for its apparently greater frequency in some geographical areas than in others. It will be obvious that a large field of investigation has been opened up by the segregation of mice into two groups of different liability, and it should be possible to obtain groups of animals of a still higher and a still lower liability. While it is at present impossible to explain how the liability is transmitted, it can be averred with certainty that it does not consist in the inheritance of a soil more suitable for the growth of cancer in general. It can only be inferred with some probability, that it is a local or circumscribed tissue predisposition, in virtue of which the mammary tissue is prone to pass from mere proliferative reaction into continuous or cancerous proliferation. Further, hereditary predisposition is only one of the factors concerned, for it has been found that chronic inflammatory changes are remarkably frequent in the mammæ of female mice of the laboratory; and other factors still unrecognised may exist. There is a considerable body of evidence to show that the predisposition is not a general one affecting the whole body equally, but that the tendency transmitted affects mainly one organ system, so that groups of animals may ultimately be obtained in which different organ-systems will present a definite predisposition, the other organs of the body not being unduly liable to the development of the disease.

To guard against pessimistic conclusions, it is well to point out that the influence of heredity has only been demonstrated by studying stocks in which this factor has been concentrated by careful mating, and that the influence is mainly exerted in the immediate descendants. Such a concentration as can be attained in experimental animals can only occur in the human subject, by hazard, as a coincidence of considerable rarity; and it is probable that the influence of heredity in the general population is manifested as an average predisposition of low general intensity.

In all previous reports guarded reference has been made to the well-known association of chronic irritation and certain forms of cancer, and it has been pointed out that, in common with all external conditions, they can only have *mediate* relation to the occurrence of cancer, the essential preliminaries which lie between them and its inception being regarded, not as their specific reactions, but as manifestations of properties inherent in the cells. The employment of the term "mediate" when directing attention to the relationship is due to an effort to elucidate those forms of cancer with which irritation is most constantly associated, without considering other forms in which the particular irritants concerned do not play a part, and due to the fact, already frequently emphasised, that the irritants have nothing in common beyond the capacity to excite extended proliferation of tissues (chronic inflammation), and their association with cancer.

The varied investigations of the past nine years have added a knowledge of new forms of irritation. It has become more and more evident that irritation, effective in one case, may be, and often is, quite ineffective in another species of animal, or even in other individuals of the same species. The experiments recorded in this report throw light both on the nature of predisposition to cancer, as alluded to above, and also on the long recognised, but inexplicable, relation between chronic irritation and cancer.

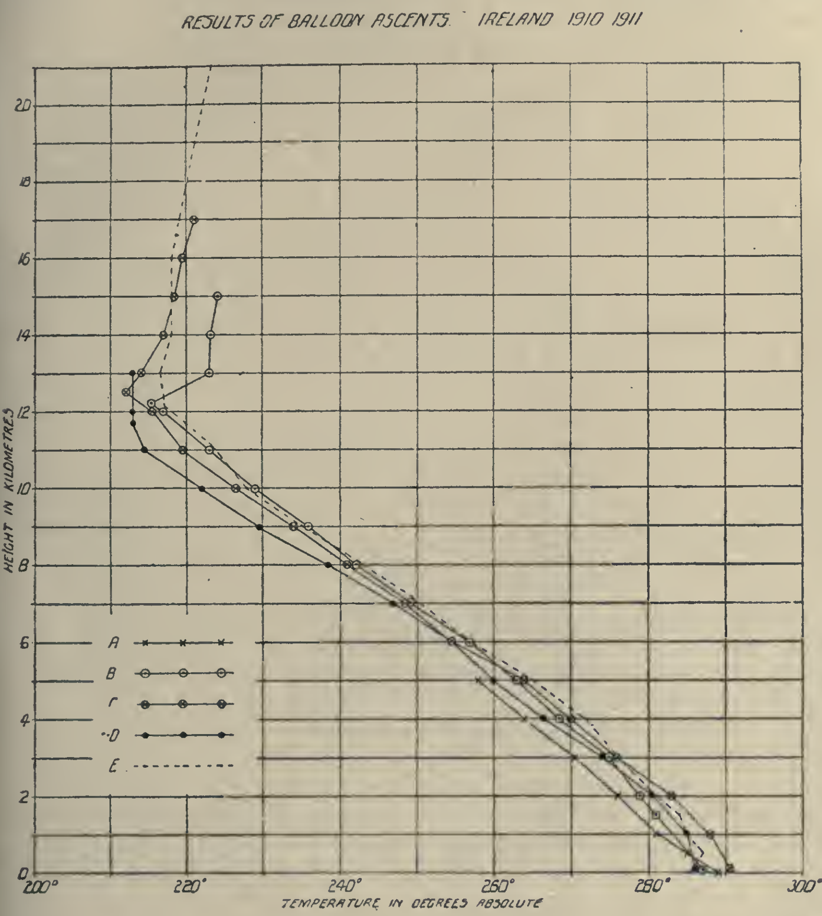
A closer definition of the nature of cancer will involve an analysis of the relation obtaining between the individual developing cancer and the tumour. This final analysis will be possible only on animals naturally afflicted with the disease, for, as pointed out consistently from the first annual report onwards, the genesis and the growth of cancer are distinct phenomena. The study of propagated cancer supplements its observation under natural conditions by investigation under varied artificial conditions, and has only an indirect bearing upon the genesis of the disease. Hence breeding experiments acquire enhanced significance, and are already being, and will continue to be, conducted on a much more extensive scale. An adequate supply of animals of differing liability to the disease must be made available for the elucidation of problems, some of which are already adumbrated; while past experience makes it likely that others, as yet unsuspected, will arise.

Because of the hope that they may ultimately have therapeutical bearings, another reference may be made to the induction of resistance to the inoculation of cancer and the means which modify the growth of transplanted tumours. Experiments along these lines bear at present upon the nature, but not upon the prevention, treatment, or cure of cancer; notwithstanding this fact the application of the results to the human subject has been urged in some quarters. In 1906–7 it was pointed out that a high degree of resistance to the transplantation of cancer did not exempt an animal from the spontaneous development of the disease. The importance of the observation was great; had immunity to the natural acquirement of cancer been also obtained, the control of the scourge would have been in sight.

In the Third Scientific Report the previous warning was re-enforced, and it was pointed out that none of the methods which had been found to influence transplanted cancer should be applied to man until they had been tested and found efficacious in the case of animals naturally affected. These warnings are borne out by further experience and inability, as yet, to modify the growth of cancer in the animal naturally affected. Instead of revealing analogies with infective diseases, and placing similar remedial and preventive measures in the hands of the physician and surgeon, the study of resistance to cancer has, until now, but brought investigators to the verge of a region filled with problems previously undreamt of. In the solution of these problems, or of more crucial ones not yet reached, lies the best hope of preventive and remedial measures; but the preliminary facts are so new to experimental biology, and as yet so imperfectly comprehended, that observers throughout the world are still engaged in discussing what may be their true significance as signposts indicating a road or roads by which the correct advance is to be made.

INVESTIGATION OF THE UPPER ATMOSPHERE.[1]

THE results of the observations at Barbados, referred to in last year's report, have been discussed by Mr. Cave in a paper read before the Royal Meteorological Society and published in its Quarterly Journal. A further supply of balloons and hydrogen has been sent to Prof. D'Albuquerque in order that he may continue the observations. Some difficulty has been experienced owing to the deterioration of rubber balloons in the climate of Barbados.



During the week August 7–13, 1910, for which international balloon ascents had been arranged over a large part of the northern hemisphere, arrangements similar to those described in last year's report were made for securing successful ascents in the British Isles, telegraphic forecasts being sent each day by the Meteorological Office to the observers. Altogether thirty-one balloons were liberated, of which nineteen were recovered and sixteen gave records of temperature to heights exceeding 10 km. Of the latter, five were sent up from Crinan, Scotland, five from Pyrton Hill, Oxfordshire, three from Manchester, two from Ditcham Park, Petersfield, and one from Oughterard, Ireland.

The British Association grant was allocated partly to ascents made by Captain Ley at Oughterard, latitude 53° 25′ N., longitude 9° 20′ W., in the west of Ireland, and partly to ascents made from Mungret College, Limerick. At Oughterard six registering balloons were sent up, and two of these were recovered. The results are shown in the diagram, A and B.

At the March meeting of the committee it was suggested that the authorities of Mungret College, Limerick, who had given evidence of keen interest in meteorological work, might be willing to liberate balloons during the international week. Such a course would avoid the recurrent expense involved in special journeys to Ireland for the ascents, and would permit of more frequent ascents being made. The college authorities expressed their willingness to fall in with the suggestion, and Mr. W. H. Dines undertook to provide instruments and balloons for preliminary ascents in connection with the short international series in June this year, and to send over someone to give necessary instructions in the preparation for the ascents.

Three balloons were liberated on this occasion, and two of them were recovered and gave records of temperature, in one case up to 17 km. The results are shown in the diagram. C, D. A balloon was also liberated from Mungret College in July, and the result is shown under E.

At the request of the joint committee, the International Commission courteously postponed the week for international ascents this year from September 4–9 to September 11–16, in order to permit of those taking part in the ascents attending the meeting of the association at Portsmouth. Arrangements have been made for further ascents from Mungret College during that week. (Since this report

Results obtained from Ascents of Registering Balloons in Ireland.

	AUGUST, 1910		JUNE, 1911		JULY, 1911
	A Oughterard, August 8, 8.10 p.m.	B Oughterard, August 11, 7 a.m.	C Limerick, June 8, 7 a.m.	D Limerick, June 9, 7.10 a.m.	E Limerick, July 6, 7.10 a.m.
Max. height	5·0 km.	15·0 km.	17·0 km.	13·0 km.	21·0 km.
Minimum temperature ...	—	216° A (at 12·2 km.)	212° A (at 12·5 km.)	213° A (from 11·7 to 13 km.)	216° A (at 12·7 km.)
Place of fall	Clear Island, Co. Mayo	Moyvore, Westmeath	Kildysart	Buttevant	Cooleeney
Distance	? 50 km.	83 km.	31 km.	48 km.	56 km.
Direction *	? 0°	80°	280°	185°	68°
H_C, T_C	—	12 km., 217° A	12·5 km., 212°, 216° A	11·7 km., 213° A	12·7 km., 216° A

Notes—B. The heights above 8 km. are rather doubtful, as the original calibration marks relating to the pressure are uncertain, and the instrument was returned badly damaged. C. Wind E.N.E., light. Faint cirrus. D. Wind N.E., force 3. Cumulus, no high clouds. A rather different type of instrument was used, and the double record may be in part due to lag. E. Calm, cloudy, cirrus moving slowly from W.

* Direction 0° = N, 90° = E.

[1] From the tenth report of a committee presented at the Portsmouth meeting of the British Association, Dr. W. N. Shaw (chairman), Mr. E. Gold (secretary).

was presented the ascents have taken place. Six balloons were liberated, and five of these have been recovered.

It is desirable that observations of pilot balloons should be obtained in Ireland in addition to the records from registering balloons, and the committee recommend re-appointment, with a grant of 50*l.*, to permit of this extension of the work. A special theodolite, costing about 30*l.*, is necessary for the observations. The additional outlay on balloons and hydrogen for the pilot-balloon observations would be comparatively small.

In the table temperature is expressed in degrees centigrade above the absolute zero $-273°$ on the ordinary scale. H_c is the height and T_c the temperature at which temperature begins to be practically constant in a vertical direction.

A SCIENTIFIC MISCELLANY.

THE Smithsonian report for the year 1910 has just been published by the institution. Besides the report of the regents and the secretary, the volume contains, as usual, a "general appendix," consisting this year of thirty-four papers of popular interest on various branches of science, also biographies of a number of prominent scientific men who have recently died. Some of the papers are original, while others are reprinted from foreign and domestic scientific and technical periodicals. All the articles are selected with the view of furnishing the latest accurate information on topics which are believed to be of interest to a wide circle.

Aviation.

A review of modern progress in aviation is ably recorded by the late Mr. Octave Chanute. His paper covers the principal advances made in aviation, beginning with the experiments of Hiram Maxim in 1894, and including Langley's experiments (1896–1903), the author's own investigations, the work of the Wrights, Dumont, de Lagrange, Farman, Blériot, Bell, Curtiss, and others, bringing the subject down to the close of the year 1909.

Reclamation of Arid Lands.

Mr. F. H. Newell, director of the Reclamation Service, sets forth the recent progress in the reclamation of the arid lands in the Western States. The work of reclamation includes all the Western States and territories, where nearly 10,000 families are being supplied with water. Through this great undertaking the waste waters of the West are being conserved, destructive floods prevented, apparently valueless lands converted into productive farms, and thousands of families settled in newly opened territory, where they are maintaining homes on reclaimed land. Besides engineering, with its business and financial problems, the article deals with many other subjects, such as the character of settlers, the size of farms, crops, &c., and the individual projects which together furnish water for about 1,000,000 acres, nearly one-half of which is already settled.

Electric Power from the Mississippi.

A kindred topic is the great electric power plant at Keokuk, Iowa, with its 4278-foot concrete dam across the Mississippi River between Keokuk, Iowa, and Hamilton, Ill. This subject is treated by Mr. Chester M. Clark in a well-illustrated article entitled "Electric Power from the Mississippi River." The paper shows the development of the largest single hydro-electric plant in existence through the construction of what is undoubtedly the greatest bank-to-bank dam in the world.

Papers on Physics, Chemistry, and Astrophysics.

Under the heading of physics there is an account, by Mr. T. Thorne Baker, of experiments and researches in the telegraphy of photographs, transmitted by both the wire and the wireless systems; Prof. Jean Becquerel, professor at the Museum of Natural History of Paris, has permitted the translation of his valuable paper on modern ideas on the constitution of matter, comparing the old theories of matter with the newer views recently confirmed by experiments; and Mr. R. A. Millikan has abridged his treatise on "The Isolation of an Ion," which deals with the exact measurement of an elemental electrical charge and several analogous problems.

Dr. Charles E. Munroe, professor of chemistry at George Washington University, and a well-known authority on explosives, has written an interesting paper on the modern developments in methods of testing explosives.

Mr. C. G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution, contributes an article on the recently developed subject of astrophysics, which is a study of celestial physics, but pertains principally to the heat and other physical properties of the sun. The paper relates to the solar constant of radiation, a topic on which Mr. Abbot is well informed, having pursued studies in that direction for nearly sixteen years at the Smithsonian Observatory in Washington, and on Mount Whitney and Mount Wilson, California. In this article the author deals with the problem of measuring the amount of solar heat received by the earth and that lost in transit to it. The subject of astrophysics is further treated by Messrs. Curtiss, Deslandres, and Bosler in three articles.

What Constitutes the Earth?

Under the title "What is Terra Firma?" Mr. Bailey Willis, of the U.S. Geological Survey, attacks the old, yet modern, problem of the construction and balance of our globe in a review of current research in isostasy. In the discussion of this puzzling question Mr. Willis advances the theory that the foundation of all the continents is composed of solid rock which is self-crushed to a depth of about 120 kilometres, but rendered sufficiently rigid by pressure to maintain its form during prolonged geological periods with but slight change.

The Future Habitability of the Earth.

In line with the construction and condition of the globe, another author, Prof. T. C. Chamberlin, brings up the further vital question "The Future Habitability of the Earth" in an article in which he reviews the past, and considers the future, of the world as a dwelling-place for the human race. Many branches of science enter into the discussion; but upon geology, physics, chemistry, astronomy, and astrophysics rests the burden of the arguments. Prof. Chamberlin thinks that the earth will remain habitable for tens of millions of years, but concedes that the close approach of a celestial body to the sun would probably result in the disruption of the solar system and bring disaster to the earth. He further states, in regard to the future possibilities of scientific research, that "when moral purpose and research come to be the pre-eminent characteristics of our race by voluntary adoption and by the selective action of the survival of the fittest, and when these most potent attributes join in an unflagging endeavour to compass the highest development and the greatest perpetuity of the race, the true era of humanity will really have been begun."

Botany and Forestry.

Several papers come under the head of botany, among them an interesting sketch of the sacred ear-flower of the Aztecs, a plant the identity of which has been a mystery for years, and only recently rediscovered by the author, Mr. W. E. Safford, of the Bureau of Plant Industry. This little flower, resembling the human ear, has a remarkable history, and dates back to the early explorations of Mexico. It was first described in 1569 by Padre Bernardino de Sahagun, who states that it was much used owing to its delicious fragrance and its flavour when used as a spice. Despite the formidable name (Xochinacaztli) which it bears, the author suggests its cultivation on account of its unusual fragrance and pleasant spicy flavour.

Mr. Henry S. Graves, chief of the Forest Service, contributes a well-illustrated and original article on forest preservation, in which he carefully considers all points in the great problem, making many things clear which have long been obscure.

Medicine and Medical Researches.

Those interested in medical research and allied subjects will find matter of concern in the following papers:—manifested life of tissues outside of the organism, by Mr. Alexis Carrel and Mr. Montrose T. Burrows; epidemiology of tuberculosis, by Prof. Robert Koch; the significance of the pulse-rate in vertebrate animals, by Dr. Florence Buchanan; and sanitation on farms, by Dr. Allen W. Freeman.

Ethnology and Anthropology.

A comprehensive paper on the contemporary Slav peoples from a geographical and statistical point of view, by Mr. Ludor Niederle, of the Bohemian University of Prague, which has been translated from the Slavic language into English, funished new information on the history and distribution of these peoples.

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, contributes a brief review of his recent work and investigations in cave dwellings, both at home and abroad. This paper is entitled "The Cave Dwellings of the Old and New Worlds."

The report also contains biographies of Melville W. Fuller, Sir W. Huggins, and Alexander Agassiz, together with papers on other subjects.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is announced that the sum of 300,000*l.* has been raised for the endowment fund for McGill University. The Duke of Connaught, in a telegram of congratulation to Mr. Angus, chairman of the McGill Campaign Committee, directs attention to the fact that this large sum was collected in five days.

In connection with the vacancy in the chair of mathematics at the University of Edinburgh, occasioned by the death of Prof. Chrystal, the curators of patronage of the University, in whom the patronage of this chair is vested, have decided to receive applications from intending candidates, along with testimonials, which should be lodged with their secretary, Mr. A. B. Fleming, 4 Albyn Place, Edinburgh, not later than Thursday, February 8, 1912.

We learn from *Science* that as a result of the action of the Michigan Board of Tax Equalisation, it is estimated that the University of Michigan will in the future receive 41,600*l.* more from the State for its maintenance than hitherto. From the same source we find that at the last session of the Legislature of the State of Minnesota, among other appropriations for the University was one which will produce 1000*l.* for each of the two years before the next Legislature assembles to be voted exclusively to research, not agricultural, since that is cared for otherwise. Our contemporary also states that by the will of Miss Phoebe Caroline Swords, of New York City, 4000*l.* is bequeathed to Columbia University.

A dinner was given at the Savoy Hotel on November 23 in aid of the fund for the erection and endowment of new buildings for Bedford College for Women. The sum of 100,000*l.* is required to complete the new buildings and provide the required endowment; and of this amount 50,000*l.*, including a grant of 20,000*l.* from the London County Council, had been secured before the dinner. The London County Council has promised a further 10,000*l.* if a like sum should be obtained without delay. The primary object of the dinner was to raise the amount necessary to secure the second donation from the London County Council; and it is satisfactory to record that at the conclusion of the dinner more than 7000*l.* had been subscribed. But 30,000*l.* will still be required, even after the second contribution from the London County Council has been received.

The most recent addition to its educational series published by the Manchester University Press is entitled "Outlines of Education Courses in Manchester University." The syllabuses of which the volume, running to 189 pages, is composed have been prepared to assist the lecture and demonstration courses given in the department of education of the university; and they are intended for the use of students. The first syllabus covers Prof. M. E. Sadler's course on the history of education in England from 1800 to 1911, and consists of exhaustive notes on each lecture, together with an invaluable bibliography directing the student to works of reference where the subjects touched upon can be studied in greater detail. Students of education everywhere will welcome this complete guide to the study of the history of education. Prof. Findlay's notes on his lectures on the principles of education are somewhat briefer, and will give the students much more to do for themselves. Here, too, frequent references to standard works on pedagogy will prove of the greatest service. The remaining discourses are more miscellaneous in character, and are dealt with in a less extended manner. The publication of the syllabuses, and the invitation extended in an introductory note to educational workers generally to criticise and advise, may be taken as a welcome indication that earnest efforts are being made in our universities gradually to build up a science of education founded upon experience and experiment.

The annual report on the 115th session of the Glasgow and West of Scotland Technical College has now been circulated. We notice that for the academic year 1910–11 there was an increase in the numbers of both day and evening students. The success with which the governors have established cordial relations with local employers of labour is very marked. For a number of years past the requests from employers for the nomination of qualified students in chemistry to fill industrial posts have been greater than the college could satisfy, and a similar position is arising in the engineering sections of the college. Most of the appointments thus gained are in works in the district, but a considerable number are abroad. Manufacturing firms in the district are recognising in increasing measure, also, the ability of the college to assist them in many of the problems arising in their industrial operations. Requests have been made to the college for reports and advice on a variety of subjects, in addition to simple questions on the strength of metals and of building materials, the accuracy of measuring instruments, and so on. Another satisfactory feature of the strengthening relations between the college and employers is the increasing number of firms which now request reports upon the attendance and progress of their apprentices at college classes. The report shows that new courses of a technical kind are arranged as soon as a new demand arises, continual additions are made to the already extensive equipment, and the building scheme is now completed. The financial position of the college appears to be in an equally satisfactory state.

We have received a copy of the report for the session 1910–11 of the work of the department of technology of the City and Guilds of London Institute. During the session 4495 classes in technological subjects were registered in 316 towns. These classes were attended by 52,680 students. So far as the examinations conducted by the institute during the year were concerned, the report shows 24,342 candidates were presented in technology from 465 centres in the United Kingdom, and of these 14,206 passed. By including the candidates from India and the Dominions overseas, and those for the teachers' certificates in manual training and domestic subjects, the total number of examinees was 27,205. This figure shows an increase on those of any previous year. During the session, too, ninety-one centres were visited by members of the institute's staff for the examination, inspection, or organisation of classes, several centres receiving two or three visits in order to complete the inspection. The report again directs attention to the criticisms and suggestions received from the examiners of the institute. We can here quote only two examples:—"Teachers would, for instance, be well advised to keep their knowledge thoroughly up to date by studying the transactions of the leading technical societies and institutions, and the articles in technical journals, and not confining themselves to text-books. In many subjects teachers should also, if possible, give more practice to students in expressing their ideas, in arithmetical work, and in careful sketching, *e.g.* by requiring the presentation of well-illustrated notes of lessons." The want of suitable and adequate preliminary education exhibited by students presenting themselves for entry into technical classes is again commented upon.

The International Council of Women has done a piece of very useful work in issuing a pamphlet on "National Systems of Education" (Aberdeen: Rosemount Press, price 3*d.*). In response to a form of inquiry drawn up by Mrs. Ogilvie Gordon, representatives of the women's organisation in most European countries, in the great self-governing communities of the British Empire, and in the United States have given us brief *résumés* of the actual

position of education in their respective countries, the whole constituting (within its limits) a valuable document for a comparative study of educational systems such as the intelligent non-expert might wish to make. Thus we find that Austria is the only European country which has compulsory evening continuation schools for boys from fourteen to sixteen years of age. In Germany, practice differs in different States, but where continuation schools are compulsory they are *day* schools, something after the pattern of our half-time schools, though, of course, the pupils are older. Primary education is compulsory in most countries, though Belgium still stands for the principle of freedom. In Russia and Finland, also, it is not yet compulsory; but in Finland it is the question of the hour, and in Russia compulsion in this matter was amongst the projected reforms of the murdered Minister Stolypin. It is interesting to note, too, that compulsory school begins earlier in England than in any other European country. In Russia elementary schools only provide for children from eight to eleven years of age. We note that the pamphlet does not include France or Italy, and that the various communications are not dated. The statement that English teachers (men) in elementary schools receive 175*l.* a year, rising by annual increments of 5*l.* to 200*l.*, would surely surprise the officials of the National Union; and the Board of Education Library is no longer in Cannon Row.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, November 8.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. E. **Hull**: The interglacial gravel beds of the Isle of Wight and the south of England, and the conditions of their formation. The origin and mode of formation of the gravel terraces of the Isle of Wight and the New Forest districts are still open to discussion. The levels of the higher beds on both sides of the Solent up to about 400 feet indicate the amount of subsidence of the whole area at a time when the stratified gravels, composed mainly of rolled flints, were formed at the margin of the uprising ridges of the Chalk in the post-Glacial epoch, for this part of England. Preceding this was the great uplift by which the British Isles were joined to the Continent as land. By this uplift the English Channel was laid dry, and along its centre there ran a river from its source about the Straits of Dover to its outlet into the ocean through the continental platform. The gravel beds of this district are considered to be the representatives of the high-level gravels of the Midlands and Cromer, also of the "interglacial gravels" of Cheshire and Lancashire, and the shell-bearing beds of the Denbighshire Hills, and of Moel Tryfaen in Wales, at levels of about 1200 feet above the sea.—J. B. **Scrivenor**: The Gopeng beds of Kinta (Federated Malay States). Gopeng is a prosperous mining centre in the Kinta Valley, close to the granite of the Main Range of the Malay Peninsula. It is shown that not only are the Gopeng beds cut by veins from the granite and altered at the junction with the granite, but they are also faulted down against the limestone. The Gopeng beds, consisting of clays and boulder-clays with some stratified drift, are of glacial origin. This is proved by the inclusion of large boulders in the clay, the physical condition of the components of the clays and their distribution, and by the resemblance of the beds to Pleistocene glacial detritus. No boulders have been found showing striation due to ice action, nor has any glaciated rock-surface been found. The boulders are all decomposed owing to the power of the ground-water in removing silica; and, if the limestone ever presented the features of a glaciated surface, it has been modified by solution owing to the action of ground-water. The petrology of the Gopeng beds is described. The ice from which the detritus was derived passed over a stanniferous granite mass, and the Gopeng beds carry tin-ore throughout. The tin-ore is an original constituent of the beds, but they have been further enriched by tin-ore derived from the Mesozoic granite at their junction with the granite and in the neighbourhood of veins from the granite that have risen through the limestone. The Gopeng beds are considered to be the equivalent in time of the Talchir boulder beds of Orissa; but a petrological similarity is wanting.

Physical Society, November 10.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. **Coker**: The effect of holes and semicircular notches on the distribution of stress in tension members. For the experimental determination of stresses in loaded members an optical examination of a model shaped in transparent material has advantages. Two cases of importance are examined in this way, and the results are compared with those obtained by analysis. The first example relates to the case of a hole in a tension member subjected to a uniformly applied stress p. The values of $(p_x - p_y)$, the difference between the principal stresses, are obtained optically, and they show agreement with the calculated values if the diameter of the hole is not greater than one-quarter of the width of the plate; but beyond this the agreement is not good. For practical purposes it is important to be able to estimate the maximum stress from the value obtained by assuming that the total load on a tension member is uniformly distributed over the cross-section. A formula based on the relationship found in the experiments takes the form

$$p_{\max} = \frac{6c^3}{2c^3 + 2c^2 + c + 1} p_{\text{mean}},$$

where c is the ratio of the width of the member to the diameter of the hole; if c is large compared with unity this reduces to the simple form

$$p_{\text{mean}} = \frac{3c}{c+1}.$$

In the case of two semicircular notches, arranged symmetrically with regard to the centre line and to the cross-section, there appears to be no exact mathematical solution; but an approximation has been obtained by Leon, resulting in expressions for p_x and p_y at the minimum section of the form

$$p_x = \frac{p}{2}\left(2 + \frac{a^2}{r^2} + \frac{a^4}{r^4}\right), \quad p_y = \frac{p}{2}\left(\frac{a^2}{r^2} - \frac{a^4}{r^4}\right),$$

provided that the radius of the notch is small compared with the breadth of the plate. Experimental determinations of $p_x - p_y$ show that the maximum values agree with those of the formulæ for notches having a maximum radius of about one-quarter of the breadth of the member, but the minimum values do not show good agreement if the notch has a radius greater than one-eighth of the breadth. The results appear to indicate that the radial stress for large notches is greater than that given by the formula. For determining the maximum stress from the applied mean stress a formula is proposed of the form

$$p_{\max} = \frac{12c^3}{6c^3 + 4c^2 + c + 1} p_{\text{mean}},$$

and this shows a fair agreement with the experimental values.

Royal Anthropological Institute, November 14.—Mr. R. W. **Williamson**: Mafulu mountain people of British New Guinea. The paper refers to an inland tribe of whom very little has hitherto been known, but among whom the author spent some time last year. The Mafulu are a short-statured people, sooty-brown in colour, with grizzly, brownish hair. The clothing of both men and women consists merely of a narrow band of bark cloth, passed between the legs and tied round the waist. They are cannibals, but not head-hunters. They live in scattered clusters of villages perched up in the summits of the mountain ridges, and are divided into clans, each clan having its own chief and village club-house. They bury their dead underground except as regards chiefs and important people, whose bodies are put into boxes fixed above ground, on clusters of poles in the village enclosure or in a species of fig tree. The author described some of their curious feasts and ceremonies, including the "Big Feast," at which the supports of one of these boxes are cut away so that the box and its contents fall to the ground; then the skull and bones within it, and those of all their other important dead, are smeared with the blood of slain pigs, after which the evil-disposed ghosts of their owners will no more disturb the people. The author suggested the possibility of these people having a partial pygmy or negrito ancestry.

Mineralogical Society, November 14.—Anniversary meeting.—Prof. W. J. Lewis, F.R.S., president, in the chair. —R. H. **Solly**: Dufrenoysite, associated with seligmannite, from the Binnental. In a small cavity, discovered in August, in the dolomite rock in the Lengenbach Quarry, were a few brilliant crystals of dufrenoysite, coated on their fractured surfaces with minute crystals of seligmannite. Measurements of two crystals of the former led to the discovery of twenty-six new forms.—H. G. **Smith**: A simple graphic method for determining extinction-angles in sections of biaxial crystals. A means of drawing a crystal projected on any plane and finding the extinction-directions was explained.—Dr. G. T. **Prior**: The meteoric stone which recently fell in Egypt. A meteorite fell on June 29 near the village of Abdel Malek, about 44 km. E.S.E. of Alexandria. It exhibits a brilliant, varnish-like crust, and consists mainly of a coarse-grained crystalline aggregate, without chondrules, of a green pyroxene and a brown ferriferous olivine with only a little felspar and practically no nickeliferous iron. A quantitative analysis showed that the stone includes a high percentage of lime, and that the green pyroxene, containing much lime as well as ferrous oxide and magnesia, constitutes about three-quarters of the stone by weight. A study of thin sections under the microscope showed that the pyroxene is generally twinned on 100, gives extinction angles as high as 35°, and exhibits "herring-bone" structure owing to fine twinning on 001.—T. **Crook** and S. J. **Johnstone**: Strüverite from the Federated Malay States. A mineral of doubtful identity found in the course of tin-mining on the Sebantum River, Kuala Kangsar district, Perak, was proved to be strüverite; it closely resembles the mineral recently recorded by Hess and Wells from South Dakota, U.S.A.—A. **Hutchinson**: The temperature at which gypsum becomes optically uniaxial. A small plate of gypsum, cut normal to the acute bisectrix, was placed in a glass-topped cell, through which a stream of water at a determinate temperature was passed, and the optic picture was studied under a microscope. The plate became uniaxial at 25° C.—A. **Hutchinson**: A total-reflection diagram. From this diagram the refractive index of a substance is graphically determined when given the angle of total reflection with respect to a known substance of higher refractive index. By taking the sine of the angle as coordinate, the curves are straight lines.—T. **Crook**: The occurrence of ankerite in coal. The white crystalline layers often found as infillings of the vertical joints in British coal are ankerite. Dolomite was not found, and calcite occurs sparingly as compared with ankerite in the specimens examined.

Royal Microscopical Society, November 15.—J. E. **Barnard**: A geometric slide photomicrographic apparatus. The apparatus was designed on the principle of the geometric slide throughout, as enunciated by Lord Kelvin and Tate. The base of the apparatus was formed of two castings designed on the girder principle, braced together at each end and in the middle. The portion to carry the microscope was also formed by a pair of castings braced together in the same way. Great rigidity was obtained, and the whole apparatus would move together if subjected to shock or vibration. Rods were fastened down on the top of the castings to support the apparatus, and the camera slid along these on two V-grooves on one side and on a plane surface on the other side. The camera was supported on vertical rods fixed on the geometric slides. The apparatus could be used equally well as a horizontal or vertical camera, or at an angle of 45°.—Rev. Hilderic **Friend**: Fridericia. The genus Fridericia was created by Michaelsen in 1889 to receive certain species of Enchytræids, eleven in number, possessed of dorsal pores and having setæ of unequal lengths. In 1895 Beddard reckoned twelve species, but not one was known as British. Moore, Friend, and others added to the list, which in 1900 stood at twenty-one. Bretscher, Issel, and others then took up the study, and at the present time some seventy or eighty species of Fridericia are known to science. The largest is *F. magna*, Friend, which has been found in England, Ireland, and Scotland, but so far has not been reported abroad. The author, whose researches into this genus began in 1896, here records no fewer than thirty species found up to the present time in the British Isles. Some of these are new to science; and a series of keys is appended to enable the student readily to distinguish the allied species.

Linnean Society, November 16.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. R. R. **Gates**: Certain aspects of the mutation problem in Œnothera. Work with the Œnotheras has developed in several directions, all bearing on the general question of the place to be assigned to mutation as an evolutionary factor. A concerted attack upon the behaviour of the Œnotheras in heredity and variation from several points of view gives a broader basis for the interpretation of the evolutionary significance of these phenomena than has hitherto been possible in most other genera. The cytological evidence has shown that in most of the mutants from *Œnothera Lamarckiana* the chromosome number is unchanged, but in the mutant *Œ. gigas* it is doubled. Hence mutants originate in various ways. Evidence goes to show that the chromosome doubling in *Œ. gigas* probably occurred either in the fertilised egg or in a megaspore mother-cell, which afterwards developed apogamously. On the other hand, in certain cases the mutational change probably occurred during the reduction divisions. Thus *Œ. rubricalyx* is a mutant from *Œ. rubrinervis*, which produces an extreme amount of pigment; and when crossed with the parent type the new character behaves as a Mendelian dominant, and in such a way as to show that the original mutant individual was heterozygous, and probably originated from a cross between a germ-cell in which the new dominant character appeared and one in which it was lacking. From this and much other evidence mutation in Œnothera appears to be due to a general condition of germinal instability, which in turn is probably connected with crossing in the ancestry. This, however, by no means deprives it of evolutionary significance, for all open-pollinated species of plants are hybrids in the sense that various races have participated in their immediate ancestry. Certain results were also communicated of *Œ. grandiflora* × *Œ. rubricalyx*, *Œ. Lamarckiana* × *Œ. grandiflora*, and other crosses which produce twin types.—G. Claridge **Druce**: Some floristic results of the International Phytogeographic Excursion through the British Isles.—A. W. **Hill**: Drawings of a viviparous specimen of *Juncus bufonius*. The seedlings were seen emerging from the parent capsule.—N. C. **Macnamara**: Mutations in foxglove plants. From a packet of foxglove seeds (*Digitalis purpurea*) sown in the year 1906, fifty-four plants were, in June, 1907, planted in a shrubbery of fir trees with an undergrowth of laurels. Of these plants fifty-one grew into normal foxgloves, but the three remaining plants were sports, which we may distinguish by the letters A, B, and C. A. In this plant the flowers of the lower half of the stem possessed only a bifid upper petal and seven stamens united at their bases. The flowers of the upper part of the spike were normal. B. A fine, well-grown plant 4½ feet high; throughout the whole length of the spike the flower consisted of a bifid upper petal, seven stamens, and style. The upper part of this spike was isolated; it produced abundant self-fertilised seed. C. The spike of this plant grew to be 5 feet high; from base to apex its flowers consisted of nine stamens and a style, with no vestige of petals. It seems that a certain number of the foxglove seeds sown in the year 1906 contained elements in a condition such as that described by de Vries as being "impressed by an impulsive mutability," for some of the flowers produced by these seeds were sports. Seeds from these sports produced their like in 1909; and, further, these latter plants produced some terminal flowers totally differing in character from the parent sport from which they were derived. Seeds from these terminal flowers produced their like in the year 1911; so that there are now two different strains of foxglove plants produced from the seeds sown in 1906, and these strains have been produced from self-fertilised flowers, that is, from flowers carefully protected from insects or other means of cross-fertilisation.

DUBLIN.

Royal Irish Academy, November 13.—Rev. Dr. Mahaffy, president, in the chair.—R. Lloyd **Praeger**: Phanerogamia. Part ii. (Clare Island Survey.) On a former occasion the question of the origin of the island flora,

and the influence upon it of human operations, had been dealt with. In the present communication the composition of the flora of Clare Island, the plant societies, and the relation of the flora to that of the adjoining islands, were dealt with. The floras of all the islands is remarkably large in comparison with those of adjoining mainland areas, pointing to former easy migration by means of post-glacial land-connections.—The following papers were also read, in connection with the Clare Island Survey:—Claude **Morley**: Hymenoptera.—D. R. **Pack-Beresford**: Arencida and Phalangida (Spiders and Harvestmen).

PARIS.

Academy of Sciences, November 20.—M. Armand Gautier in the chair.—J. B. **Charcot**: The laboratory for scientific maritime researches of the *Pourquoi-Pas?* It is suggested that the vessel *Pourquoi-Pas?* which served for the last French Antarctic expedition, would form a very serviceable laboratory for marine biological researches. Its present equipment is described, and an appeal for the necessary funds is made.—M. **Borrelly**: Observations of the periodic Borrelly comet (1911*e*) made at the Observatory of Marseilles with the comet finder. Data are given for November 13, 14, 15, and 16. The comet is moderately bright, of the tenth magnitude, its extent being 2′.—P. **Montel**: Some analytical functions which admit of two exceptional values within one region.—G. **Kœnigs**: Surfaces which, in the course of a given movement, are continually osculating to their conjugated profile.—Raoul **Bayeux**: An apparatus of precision for the use of gaseous oxygen in physiology and therapeutics. In the instrument described and illustrated the usual indiarubber bag is replaced by a small cylinder of compressed oxygen controlled by a double metallic governor composed of two capsules similar to those used in the aneroid barometer. There is a specially designed sensitive tap for the distribution, and the amount of gas available at any instant can be read directly.—C. **Gutton**: The velocity of propagation of electromagnetic waves along a line of metallic wires.—V. **Auger**: The action of hydrogen peroxide upon the oxygen compounds of iodine. Details are given of the interaction of hydrogen peroxide with neutral and basic alkaline periodates, periodic acid, and iodic acid.—MM. **Desgrez** and **Feuillié**: The estimation of urea. The methods of Folin, Mörner, and Sjœqvist are exact, but require too much time for biological investigations, necessitating a large number of estimations. The method described is based on the use of Millon's reagent. It has been objected that Millon's reagent acts upon other nitrogenous substances besides urea, but experiments made with salts of ammonia, uric acid, creatine, creatinine, hypoxanthine, tyrosine, xanthine, leucine, guanine, and allantoin showed that the last-named substance alone interferes. The proportion of allantoin in human urine is so small that this complication cannot be considered as a real objection to the process. The necessity of suitably fixing the temperature at which the reaction is carried out is emphasised.—Marcel **Godchot** and Félix **Taboury**: Some derivatives of cyclopentanone. In a previous communication a new ketone, $C_{10}H_{16}O$, was obtained by the hydrogenation of cyclopentanone by the method of Sabatier and Senderens, and its constitution was provisionally suggested as α-cyclopentylcyclopentanone. In the present paper this formula is confirmed by additional experiments.—J. **Vallory**: Studies in the reproduction of *Chaetomium kunzeanum*, var. *chlorinum*.—P. **Desroche**: The mode of action of coloured light on the Chlamydomonas. Blue rays have a paralysing action on the zoospores, whilst the red rays have a stimulating action.—J. **Tournois**: Floral anomalies of *Humulus japonicus*.—C. L. **Gatin** and M. **Fluteaux**: The anatomical modification produced in certain plants by the dust from tarred roads. It has been shown in a previous communication that the trees in certain parts of the Bois de Boulogne have been adversely affected by the action of the dust from the treated road. In the present paper it is shown that these effects are accompanied by certain anatomical modifications in the plant.—E. **Milliau**: The detection of carbon bisulphide in oils.—E. **Vasticar**: The structure of Corti's fibres.—R. **Robinson**: New arguments in favour of the action of the suprarenal capsules on the determination of sex. A summary of the facts known on the relation between the condition of the suprarenal capsules and the sex of the embryo.—A. **Pézard**: The determination of the secondary sexual characters in the Gallinaceæ.—Anna **Drzewina**: Rapid modifications of form under the influence of deprivation of oxygen in a Medusa, *Eleutheria dichotoma*.—Albert **Frouin** and Arthur **Compton**: The loss of activity of trypsin by dialysis into distilled water, and the regeneration of the activity by the addition of salts. From the experiments described the authors conclude that the presence of salts is necessary for the trypsin to exert a proteolytic action.—Louis **Germain**: Atlantis. A review of the principal palæontological and zoological arguments in favour of the actual existence of the vanished continent, Atlantis.—Maurice **Piettre**: The melanins.—A. **Moutier**: The mechanism of general or local troubles of the arterial circulation leading to general or local arterio-sclerosis. Instruments such as sphygmomanometers are generally regarded as measuring the pressure of the blood in the interior of the artery. This the author has shown to be erroneous, the force of compression being exclusively a function of the elastic state of the arterial wall, and independent of the manometric pressure. Additional experimental evidence in favour of this view is given.—Ch. **Moureu** and A. **Lepape**: The ratios of the rare gases between themselves and with nitrogen in fire-damp. The examination of the inert residues from six samples of fire-damp shows that the crude nitrogen from the fire-damp presents a striking analogy with crude nitrogen from other natural mixtures.—Alfred **Angot**: The earthquake of November 16, 1911. The true amplitude of the horizontal movement of the ground at Paris was of the order of a millimetre.

CAPE TOWN.

Royal Society of South Africa, October 18.—Prof. H. H. W. Pearson, vice-president, in the chair.—J. **Moir**: The spectrum of ruby. Part iii. Two further very faint spectrum lines are described. The artificial ruby has been analysed, and chromium detected as the colouring matter. When a ruby is heated above 300° C. it changes, through scarlet and brown, to the colour of chromium glass, and all the characteristic spectrum lines disappear. It recovers completely on cooling. The effect of heat on the birefringence of corundum has been studied, and has been found to be insignificant The spectrum of ruby is therefore due to chromium in a special atomic condition, which does not apparently occur elsewhere in nature.—Dr. and Mrs. J. R. **Sutton**: Some causes and effects of variation in the range of temperature. The paper contains the results of a discussion of some of the more salient meteorological aspects of a variation in the range of temperature. It deals in a general way with the changes of temperature, moisture, pressure, and sunshine, which go with a variation in the range of temperature, monthly means being used. Harmonic constants of barometric pressure and temperature are computed for months of great and small range of temperature respectively.—R. T. A. **Innes**: Algebraic development of the elliptic perturbative function used in the theories of planetary motion. The paper presents tables whereby the functions which operate on the ratio of the semi-axes can be easily calculated to any order of the eccentricities and mutual inclination, so far as regards primary and secondary terms, which alone have any importance in the planetary theories. The paper concludes with an explicit development of the secular part of the perturbative function to any order.—B. de St. J. **Van der Riet**: A supposed new mineral from Du Toit's Pan, Kimberley. The supposed new mineral from Du Toit's Pan, Kimberley, reported in NATURE of September 7 by Mr. J. R. Sutton, appears to the author to be derived from a well-known artificial material, viz. commercial calcium carbide. It is certain that acetylene generators have been in use on the mine for years, and it is quite possible that a portion of the waste from the acetylene machines has in some manner found its way to the pulsator, where the supposed mineral was discovered. It has been found possible to compare specimens of the substance referred to (kindly supplied by the general manager of De Beers' Co.) with the lumps and pellets which settle in the lime residue from generators supplying acetylene gas to the chemical laboratory of Victoria College. In

chemical as well as physical characters there is an unmistakable similarity between the two products. Thus (1) slaked lime, which, of course, accompanies carbide pellets, can be detected in some of the cavities on surfaces of the pulsator pellets. (2) Variations in hardness, form, colour, fracture, size of pellets, and peculiar markings are faithfully reproduced. (3) In either case the lumps and pellets vary in composition from iron carbide, attacked by dilute acids, to iron silico-carbide, which is attacked by hydrofluoric acid, but not by hydrochloric and sulphuric acids. (4) The pellets from either source give off an odour of acetylene when crushed. (5) The pulsator pellets, as well as ordinary carbide pellets, do not contain, so far as can be found, notable quantities of titanium. In an iron mineral derived from the ilmenite of "blue ground," by reduction at a high temperature, one should certainly expect to find titanium.—J. C. **Beattie**: Further magnetic observations in South Africa during the years 1910 and 1911. The communication contains the reduced results of observations in various parts of South Africa during 1910 and 1911 for determining the secular variation of the magnetic elements. It also contains results of additional observations in the West Transvaal and the east of Cape Province, with a discussion of the magnetic states of these regions.—W. A. Douglas **Rudge**: Action of radium salts on glass. An account of experiments carried on during the past three years in order to study the prolonged action of radium salts upon glass. Small quantities of radium were sealed up in thick-walled tubes, and the extent to which the coloration extended determined by cutting up sections of the tube, polishing the ends, and examining with a microscope. The tint developed depended upon the nature of the glass employed, and the depth of penetration depended upon the structure of the glass. Many kinds of glass show a "zonal" structure, and an abrupt change in the depth of coloration appears at the junction of successive zones. The width of the zones were measured with a micrometer, the first and darkest being 0·27 mm.; the others extended right up to the external walls of the tube, a distance of 2·48 mm. from the bore. If the coloration is due to X particles alone, the range must be much greater than would be deduced from the experiments of Rutherford and Joly. There is evidently some obstacle met with to the free passage of the rays at each zonal layer, as the coloration shows. The action of even a very impure radium salt is comparatively rapid; a few milligrams of a salt, containing about one-thousandth of its weight of radium, causes a very definite coloration at the end of twenty days, the first zone being then clearly defined. The coloration must be due to B and Y, as well as X, rays and emanation.—J. **Burtt-Davy**: A new species of Mesembryanthemum from the Transvaal, and notes on the genus Ficus.

New South Wales.

Linnean Society, September 27.—Mr. W. W. Froggatt, president, in the chair.—Archdeacon F. E. **Haviland**: Notes on the indigenous plants of the Cobar district. The Cobar district may be said to comprise the country within a 50-mile radius of the town of Cobar, embracing an area of about 6000 square miles. It is flat, with occasional hills rising abruptly. The town of Cobar is 805 feet above sea-level, and the distance from the coast about 420 miles. The district is droughty, with prevailing high temperatures and a dry atmosphere, the average annual rainfall being about 14 inches. The flora is a typical inland, dry-country flora, the general appearance of the vegetation being that of brushwood, few trees of any kind attaining any considerable dimensions. The plants met with represent 161 genera and 284 species of Dicotyledons, 30 genera and 47 species of Monocotyledons, and 5 genera and 6 species of Acotyledons.—R. H. **Cambage**: Notes on the native flora of New South Wales. Part viii. Camden to Burragorang and Mount Werong. One of the features brought out is the marked influence of climate upon plant distribution, for, as the mountain is ascended, the vegetation is found to correspond more nearly with that of Tasmania, where a similar climate prevails. Between Camden and Burragorang, at altitudes ranging up to 1800 feet, 30 per cent. of the species are Tasmanian; but between Colong and Mount Werong, at altitudes varying from 2000 to 4000 feet above sea-level, about 48 per cent. of the plants seem to belong to species which occur in Tasmania. Reference is made to the occurrence of the narrow-leaved ironbark (*Eucalyptus crebra*) around Colong at altitudes up to 2500 feet, which is unusual in latitudes south of Sydney; its presence may generally be regarded as an indication that the rock producing the soil upon which these trees grow contains upwards of 60 per cent. silica. Although it will thrive on rather poor siliceous soils, it is absent from excellent basaltic soil a few yards away, but which contains less than 45 per cent. silica; and the question is raised whether it may not be rather the physical conditions of the soil than the chemical constituents which regulate the distribution of this tree.—R. J. **Tillyard**: The genus Diphlebia (Neuroptera: Odonata), with descriptions of new species and life-histories. The genus Diphlebia is one of three closely allied genera, grouped by de Selys to form the sixth legion (Amphipteryx) in his classification of the subfamily Calopteryginæ—Devadetta (=Tetraneura of Selys) from the Malay Peninsula, Siam, and Borneo, Amphipteryx from Colombia, and Diphlebia from Australia, represented, hitherto, by two species. Two additional species of the last of these are described as new, one from Kuranda, North Queensland (Dodd), and the other from rocky creeks in the Nandewar Ranges, New South Wales. The life-history of the latter has been worked out. In the Anisoptera, the characters of the larval gizzard determine the separation of the main groups. The same test should be applied to the unsatisfactory classification of the Zygoptera.

BOOKS RECEIVED.

Chemistry Note-book. By E. J. Sumner. Pp. 92. (Burnley: Cooper Printing Co., Ltd.) 2*s*.

Photograms of the Year, 1911–12. Typical Photographic Pictures Reproduced and Criticised. Edited by H. S. Ward. Pp. 154. (London: G. Routledge and Sons, Ltd.) 2*s*. 6*d*. net.

The Rainfall of Jamaica from about 1870 to end of 1909. By M. Hall. Pp. 27+14 maps. (Jamaica.)

Upon the Inheritance of Acquired Characters. A Hypothesis of Heredity, Development, and Assimilation. By E. Rignano. Authorised English translation by Prof. B. C. H. Harvey. With an Appendix upon the Mnemonic Origin and Nature of the Affective or Natural Tendencies. Pp. iv+413. (Chicago: Open Court Publishing Co.) 12*s*. 6*d*. net.

The Calorific Power of Gas. A Treatise on Calorific Standards and Calorimetry. By J. H. Coste. Pp. xvi+310. (London: C. Griffin and Co., Ltd.) 6*s*. net.

Junior Mathematics: being a Course of Geometry and Algebra for Beginners. By D. B. Mair. Pp. viii+200. (Oxford: Clarendon Press.) 2*s*.

Ministry of Education, Egypt. Records of the School of Medicine. Vol. iv. Part ii. By Dr. A. Looss. Pp. viii+163–613+plates xi–xix. (Cairo: National Printing Department.)

The Stars from Year to Year; with Charts for every Month. By H. P. Hawkins. Fifth edition. Pp. 23. (Bedford: Beds. Times Publishing Company, Ltd.) 1*s*. net.

The Star Almanac for 1912; with Star Charts of the Seasons, the North America Nebula, Solar Eclipse, &c. By H. P. Hawkins. (Bedford: Beds. Times Publishing Company, Ltd.) 6*d*. net.

The Star Calendar for 1912, with Revolving Chart. By H. P. Hawkins. (Bedford: Beds. Times Publishing Company, Ltd.) 1*s*. net.

The Evidence for the Supernatural. A Critical Study made with "Uncommon Sense." By Dr. I. Ll. Tuckett. Pp. vi+399. (London: Kegan Paul and Co., Ltd.) 7*s*. 6*d*. net.

Forecasting Weather. By Dr. W. N. Shaw, F.R.S. Pp. xxvii+380. (London: Constable and Co., Ltd.) 12*s*. 6*d*. net.

Boiler Draught. By H. K. Pratt. Pp. vi+138. (London: Constable and Co., Ltd.) 4*s*. net.

The Colloidal and Crystalloidal State of Matter. By Prof. P. Rohland. Translated by W. J. Britland and H. E. Potts. Pp. 54. (London: Constable and Co., Ltd.) 4*s*. net.

Applied Biology: an Elementary Text-book and Laboratory Guide. By Prof. M. A. and A. N. Bigelow. Pp. xi+583. (London: Macmillan and Co., Ltd.) 6s. net.

Revolving Vectors with Special Application to Alternating Current Phenomena. By Prof. G. W. Patterson. Pp. vi+89. (London: Macmillan and Co., Ltd.) 4s. 6d. net.

Stability in Aviation. An Introduction to Dynamical Stability as applied to the Motions of Aëroplanes. By Prof. G. H. Bryan, F.R.S. Pp. x+192. (London: Macmillan and Co., Ltd.) 5s. net.

The Making of Northern Nigeria. By Captain C. W. J. Orr. Pp. x+306. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

The Land of Uz. By Abdullah Mansûr (G. Wyman Bury). Pp. xxviii+354. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

Fourth Report of the Wellcome Tropical Research Laboratories at the Gordon Memorial College, Khartoum. Vol. A—Medical. Pp. 404+xxiii plates+118 figures. (London: Baillière, Tindall and Cox.) 21s. net.

The Recent and Fossil Foraminifera of the Shore-sands at Selsey Bill, Sussex. By E. Heron-Allen and A. Earland. (Printed by W. Clowes and Sons, Ltd., London.)

The Ontario High School Physics. By Dr. F. W. Merchant and Prof. C. A. Chant. Pp. viii+504. (Toronto: Copp, Clark Company, Ltd.) 90 cents.

The Ontario High School Laboratory Manual in Physics. By Dr. F. W. Merchant and Prof. C. A. Chant. Pp. viii+128. (Toronto: Copp, Clark Company, Ltd.) 35 cents.

Ministère de l'Agriculture. Direction de l'Hydraulique et des Améliorations Agricoles. Service des Grandes Forces Hydrauliques (Région des Alpes). Études Glaciologiques. Tome ii. Savoie—Programme pour l'Étude d'un Grand Glacier. Pp. vii+140.

The Indian Forest Memoirs. Forest Botany Series. Vol. i. Part i.—On some Indian Forest Grasses and their Œcology. By R. S. Hole. Pp. iv+126+xl plates. (Calcutta: Superintendent of Government Printing, India.) 8s. 6d.

The Transactions of the Linnean Society of London. Second series—Zoology. Vol. xi. Part vi.—On the Life-history of *Chermes himalayensis*, Steb., on the Spruce (*Picea Morinda*) and Silver Fir (*Abies Webbiana*). By E. P. Stebbing. Pp. 99–124+plates 20–23. (London: Linnean Society.)

DIARY OF SOCIETIES.

FRIDAY, DECEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Brake-lining Coefficients of Friction: J. and W. Legg.

GEOLOGISTS' ASSOCIATION, at 8.—(1) Note on a Maxilla of Triconodon from the Middle Purbeck Beds of Swanage; (2) On Prehistoric Paintings and Drawings in the Caverns of Northern Spain: Dr. A. Smith Woodward, F.R.S.

MONDAY, DECEMBER 4.

SOCIETY OF ENGINEERS, at 7.30.—The Design of Tall Chimneys: H. Adams.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Physical Properties of Clays: W. C. Hancock.—The Value of the Non-tannins in the Formation of Leather: Dr. J. Gordon Parker and R. J. Blockey.—The Estimation of Carbon Monoxide: L. A. Levy.—The Composition of Bassia Fats: Russell G. Pelly.

ARISTOTELIAN SOCIETY, at 8.—Animism and the Doctrine of Energy: Dr. T. P. Nunn.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography and Economic Development of British Central Africa: Sir Alfred Sharpe, K.C.M.G., C.B.

ROYAL SOCIETY OF ARTS, at 8.—The Carbonisation of Coal: Prof. Vivian B. Lewes (Lecture II.).

TUESDAY, DECEMBER 5.

RÖNTGEN SOCIETY, at 8.15.—The Energy of the X-Ray: Prof. W. H. Bragg, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Electric Lighting of Railway Trains: the Brake-Vehicle Method: R. T. Smith.

WEDNESDAY, DECEMBER 6.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Small Quantities of Essential Oil in Spices, etc. (Part II.): J. A. Brown.—The Determination of Furfural by Means of Fehling's Solution: Lewis Eynon and J. H. Lane.—The Examination of Petroleum Mixtures: J. H. Coste, E. T. Shelbourn, and E. R. Andrews.—Note on Ground Almonds: G. C. Jones and R. F. Easton.—A Method for Determining the Amount of Insoluble Particles in Raw Rubber: C. Beadle and Dr. H. P. Stevens.—Note on the Determination of Small Quantities of Methyl Alcohol: C. Simmons.—Note on Oil of Male Fern: Ernest J. Parry.—(1) The Composition of Australian (Victoria) Milk; (2) The Composition of Sweetened Condensed Milk; (3) The Aldehyde Figure of Butter: E. Holl Miller.

FARADAY SOCIETY, at 8.—A Redetermination of the Density and Coe[illegible] of Linear Expansion of Aluminium: Dr. F. J. Brislee.—The Solar[illegible] Volumes of Nitric Acid: V. H. Veley, F.R.S.—The Influence of [illegible] Physical Condition of Metals on Cathodic Over-voltage: Dr. J. N. Pri[illegible] and J. R. Curzon.—Notes on Thermostats: Prof. Hugh Mar[illegible] F.R.S.—Notes on Two Thermo Regulators: W. R. Bousfield, K.C.—Notes on Thermostats and Devices used in Connection with Therm[illegible]: Dr. A. C. Cumming.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 8.—British Guiana and its Founder, St[illegible] van 's Gravesande: J. A. J. de Villiers.

GEOLOGICAL SOCIETY, at 8.—The Faulted Inlier of Carboniferous Li[illegible]stone at Upper Vobster (Somerset): Dr. T. F. Sibly.—Geology of a P[illegible] of Costa Rica: James Romanes.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Lapworthura: a Typica[illegible] Brittlestar of the Silurian Age, with Suggestions for a New Classificat[illegible] of the Ophiuroidea: Miss I. B. Sollas and Prof. W. J. Sollas, F.R.S.—The Physiological Influence of Ozone: Dr. Leonard Hill, F.R.S., [illegible] M. Flack.—On the Factors Concerned in Agglutination: H. R. Dea[illegible].—The Action of Dissolved Substances upon the Auto-fermentation of Ye[illegible]: Dr. A. Harden, F.R.S., and S. G. Paine.—Further Experiments u[illegible] the Blood Volume of Mammals and its Relation to the Surface Area [illegible] the Body: Prof. Georges Dreyer and W. Ray.—The Origin and Dest[illegible] of Cholesterol in the Animal Organism. Part viii. On the Cholester[illegible] Content of the Liver of Rabbits under Various Diets and During Ina[illegible]tion: G. W. Ellis and J. A. Gardner.

LINNEAN SOCIETY, at 8.—The Internodes of Calamites: Prof. Percy Groom.—On Some Mosses of New Zealand; H. N. Dixon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on National [illegible] International Standards for Electrical Machinery: Dr. R. Pohl.

CONTENTS.

THURSDAY, DECEMBER 7, 1911.

HEALING BY TOUCH.

The King's Evil. By Dr. Raymond Crawfurd. Pp. 187. (Oxford: The Clarendon Press, 1911.) Price 8*s.* 6*d.* net.

THE history of the king's evil and the royal touch, whether as a picture in detail of a certain stream of a very ancient tradition, or as a particular instance of something more than a tradition or symbol, of a mystic interpretation of man's relation to the unseen powers which encompass him, is a deeply interesting study. We are far from imputing it as a fault to Dr. Raymond Crawfurd if, in his scholarly decision to keep to his own part of a great subject, and to do thoroughly what he undertook, he has averted his eye from the ancient sources of the mystery, or even neglected the facts and fables which linked up the modern and the ancient modes of miraculous healing. Still, has not Dr. Crawfurd almost dissembled these sources of the far past and the ancient myth? He remarks, for instance, that the gods "have transmitted the gift" (of healing) to mortal man—especially to conspicuous individuals such as kings; to Pyrrhus, for example, or Vespasian. And a few sentences farther on (p. 10) he says that, with the spread of Christianity, the priest "usurped" for a while the prerogative of healing. This seems scarcely the right colour to put upon the past. Samuel looked upon Saul as the usurper of intercessory functions. And the gift of healing was not so much a "transmission" from gods to men as that in this function the priest-king originally was the organ rather than the agent of the supernatural; originally the potency was not so much a delegation as a continuity.

The laying on of hands, as practised for disease in England and France, and as still practised in the institution of Holy Orders, passed by insensible gradations from gods and godlings to heroes and men. Any kindred touch might convey its influence, even the touch of a relic of the operative personage. From this point of view, in Greece, *χεὶρ* and *δύναμις* were equivalent. And in various times and circumstances the manual act might pass a stream of virtue from healer to patient, or might be a manumission, or a protective gesture, or merely a symbol. Clearly, in the idea of the royal touch, it stood for more than a symbol.

The "soothing-handed" (*ἠπιόχειρει*) Chiron, Eileithyiæ, Apollo, Hygieia, poured forth their virtue to Asclepius, Serapis, the mother of God (*χεὶρ τῆς Παναγίας*), Cosmas and Damian, and onward, until we take up the modern part of the story with Dr. Crawfurd, from Robert the Pious (996–1031 A.D.). If in view of the inclination of the readers of NATURE towards evolution I have ventured to knit up a few of these ancient links, from the beginning of his own story Dr. Crawfurd is an indispensable guide. From the first we feel we are in good hands; the scrupulous references to authorities, the exploration of the sources, many of which the author has either brought to light or has set in their proper light, the first glance at the scholarly translations from the Latin, or at the excellent bibliography, and, above all, the sound criticism not unspiced with humour, give the reader a sense of completeness and sureness. The subject of the royal touch had not been adequately treated; Dr. Crawfurd has been fortunate in his subject, and has produced an exhaustive and probably a final study of it.

Magic touch in ancient times was valid not for a few but for all or any diseases and for parturition. In the Middle Ages, however, it had become restricted to jaundice—the *morbus regius*—and to bubos. For the jaundice the touch soon fell out of use; the bubos were chiefly of the scrofulous kind, but Dr. Crawfurd supposes that not a few ambulant cases of bubonic plague (*lues inguinaria*) were included in the crowd. At a later date probably syphilis came in, a disease not mentioned, I think, by the author, though as he has forgotten an index—the only defect in his scholarly apparatus—I cannot be sure of this. In one of the Continental galleries I remember a picture, of the early sixteenth century, commemorating a cure by a miracle-working saint, in which the patient exhibited in his own person a fine specimen of syphilitic ulceration and of the painter's veracity.

If we regard the laying on of hands as an ancient prerogative, one deriving from the larger function of "Binding and Loosing," we attach less importance to the defects of the records of its appearance in modern times; we guess that this mystery never died out; that the lack of records is due to their destruction, or to silence on matters of familiar custom. Still, Dr. Crawfurd is as precise as sources will allow, and it is not without interest to note that, if in France the definite history of the touch begins with Robert the Pious, yet the legends of the times of Clovis suggest in this respect also the continuity of Gallo-Roman ritual. With Clovis, as with later kings of England and France, with Queen Anne for instance, the assumption of this prerogative may have been to prove that he too was hedged about with divinity. England, in her comparative isolation from the Roman tradition, records no royal touch before Edward the Confessor.

If it was not until much later times that the kings became specialists in scrofula the previous vagueness depended largely on that of contemporary diagnosis. And here we come to matter of interest to our faith-healers of to-day; to the partnership of physician and priest or king—priest or king as the touch was, generally speaking, conducted under an imposing courtly and religious ceremony. Dr. Crawfurd carefully reproduces the Offices as modified from time to time, and he tells us that the enthusiasm of the sick was thus exalted to an amazing passion. Moreover, the king's physicians took a prominent part, not only in protecting him from crowds of sufferers of a nondescript kind, or of kinds not amenable to the royal touch, but actively in securing this blessing for the cases in which their skill had failed, and for persons in whom they were interested. Passing over earlier and cruder ages, we may descend in time to so great

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a man as Wiseman, the really distinguished, sagacious, and learned sergeant surgeon to Charles the Second, who said of his master's potency, with probably more than a courtier's sincerity, that "he cureth more in any one year than all the Chirurgions of London have done in an age." This testimony is the more remarkable as Wiseman was not himself officially concerned with the ceremony. In one passage, indeed, Wiseman attributes a relapse to the loss of the angel from the neck of the patient. Like Alexander of Tralles, good doctor as for his time he was, he still clung to amulets and such magic. We read then with no surprise the devout appreciations of such men as Fuller and Collier. Shortly before Wiseman, we have the curious story, one better known to medical men, of the arraignment of one Leverett, at the instance of William Clowes the Younger, surgeon to Charles the First, before the College of Physicians for his imposture, which this august body had no difficulty in proving by convincing evidence of facts, in pretending to vie with the king in the power of curing the evil, even by methods still more magical. We do not find, however, that the College did the fairest thing in its power; it might have put the King and Leverett severally to trial on the same patient or patients. But, as Clowes aptly remarked, Leverett was not even a seventh son of a seventh son; he proved to be only the fourth. He was a hollow rogue.

Still, the sceptic had crept near the ears of his world, even at an early date; not always knowing himself to be a sceptic. John of Gaddesden (under Edward the First) assigned to the royal touch a place midway between the polypharmacy of the physician and the craft of the surgeon—"a delicate provision," says Dr. Crawfurd, "for the contingency of the king's therapeutical impotence." As this passage is almost the only original suggestion in his "Rosa Anglica," we may guess that John, like the many persons who do not know that they are humorists, was naïvely unaware of his own scepticism. It is a happy biographical trait of Henry of Navarre that, at Ivry, on cutting down a man with his sabre, he exclaimed, "Je te touche, que Dieu te guérisse." But perhaps this says less for Henry's scepticism than Dr. Crawfurd thinks, characteristic of him as the story is. Even in the sixteenth century the stronger the creed the safer to jest with it; the Church has always tolerated the jester, while handing over the wrangler to the secular arm.

The first great sceptic, to whose robust disdain of this item of his divinity the discredit of the touch is due, was William the Third. His sturdiness did him the more honour as such a proof of his dynastic authenticity would have been convenient. This testimony had more weight with Anne; though it would have gone hard with her heirship had it depended on her cure of Samuel Johnson. The gold touch-piece she bestowed upon her eminent patient is, we are told, in the British Museum. It is hard to believe that such great modern surgeons as Alibert and Dupuytren presented sufferers from the evil to Charles the Tenth; perhaps they were the last medical authorities to be so complaisant; though the later Stuarts amused themselves, and others, by clinging to this last rag of their divinity until their dissolution.

I hope my readers will agree with me that I have taken no improper liberty with them in dwelling at this length upon so able and entertaining a volume.

CLIFFORD ALLBUTT.

GROUP-THEORY.

Theory of Groups of Finite Order. By Prof. W. Burnside, F.R.S. Second edition. Pp. xxiv+512. (Cambridge: University Press, 1911.) Price 15s. net.

IN the new edition of Prof. Burnside's standard work important changes have been made by rearrangement of old material, and by addition of new. The main feature, for which many English readers will be very grateful, is the addition of several chapters on groups of linear substitutions. Among the most important of all contributions to group-theory must be reckoned the memoirs of Frobenius in the Berlin *Sitzungsberichte*; unfortunately they are not very accessible to English students, and are by no means easy to read; hence, Prof. Burnside's connected, and in many ways independent, discussion of this part of the theory is very welcome. In particular, there is a chapter on characteristics, and another on various special applications; it may be noticed, as showing the power and value of the characteristic-theory, that the theorem "every group whose order contains only two distinct primes is soluble," appears as a corollary.

At present, the theory of groups is in a very interesting state for various independent reasons. Several great mathematical theories are intimately associated with group-theory, or at least with some aspect of it; thus, there is the theory of algebraic equations, the division of period and argument in elliptic functions, and the immense field of elliptic modular functions—to mention these alone. But, besides this, the theory of groups, which so long seemed a rather arid appendix to the theory of permutations and combinations, has changed its aspect into a definite, independent, and fascinating branch of analysis, as peculiar and baffling as the theory of numbers, if not more so. It has now been approached and studied under four, at least, of its Protean aspects; as defined, in the abstract, by a multiplication-table, or, equivalently, by a set of formal equations like $a^2=b^2=(ab)^2=1$; as a set of permutations; as a set of linear substitutions; and as a set of geometrical operations. Each of these methods has suggested intrinsic properties of groups, and we have now a considerable set of distinctive epithets, such as "self-conjugate," "Abelian," "metabelian," "soluble," and so on, each of which marks a definite advance in classification. But some of the most obvious problems seem as far from solution as ever; for instance, it seems probable that no group of odd order, except a cyclical one, can be simple, but the proof has still to be found.

There is, therefore, abundant field for research, and the more varied the interests and attainments of those who undertake it the better, because some new symbolism, or some new association with geometry, or the like, may lead to the discovery of new properties

of groups. Oddly enough, on the other hand, group-theory assumes less preliminary knowledge than anything else except arithmetic, so that beginners, in a sense, start level, and have equal chances for a prize. Many of Prof. Burnside's examples, and, in particular, the notes at the end of the volume, are intended to suggest various lines of research.

It has already been observed that some of the matter of the first edition has been rearranged. The general effect has been to put more of the abstract theory in the earlier chapters; this will probably commend itself to experts, but will not make the book easier for beginners. They will probably find it convenient to pick and choose, and pay special attention to examples; they might begin by reading chaps. i.–v., vii.–ix., xviii.–xx., passing lightly over the more difficult parts; they must, in any case, become quite familiar with transformation, conjugate and self-conjugate operations and sub-groups, and the meaning of Hölder's symbol G/H. The great landmarks in the less advanced part of the theory are the properties of composition-series and their allies, together with Sylow's theorem and its consequences; these, at any rate, must be fully mastered before trying to advance.

The English student of group-theory is now fortunate in having at his disposal three excellent text-books in his own language: Mr. Hilton's "Finite Groups," which is a capital introduction to the subject, with plenty of easy examples; the present volume; and Prof. Dickson's "Linear Groups," which is particularly valuable for its completeness of detail, and its analysis of Galois fields. Our younger mathematicians are now fairly free from the shackles of ancient tradition, and we may confidently hope that some of them will add to our knowledge of this fascinating theory.

G. B. M.

A GUIDE-BOOK FOR INDIA.

A Handbook for Travellers in India, Burma, and Ceylon, including the Provinces of Bengal, Bombay, Madras, the United Provinces of Agra and Lucknow, the Panjab, Eastern Bengal and Assam, the North-West Frontier Province, Baluchistan, and the Central Provinces, and the Native States of Rajputana, Central India, Kashmir, Hyderabad, Mysore, &c. Eighth edition, with 80 maps and plans. Pp. cxvi+530. (London: J. Murray; Calcutta: Thacker, Spink, and Co., 1911.) Price 20*s.* net.

THE handbook to India, Burma, and Ceylon issued by Mr. John Murray, which now appears in its eighth edition, has reached its present form after a long series of revisions. It was first published between 1859 and 1883 in four volumes, and was the work of a well-known Oriental scholar, the late Captain E. B. Eastwick, who collected the material during several journeys to India. When we remember that in the period immediately following the Mutiny of 1857 communications throughout the Empire were imperfect, and that the present vast library of Indian books of reference, such as the imperial and provincial gazetteers, the census, archæological, and other departmental reports were not available for reference, Captain Eastwick's work was, in its way, admirable. Since the book appeared in its original form it has been subjected to constant revision by competent scholars, and has now been practically rewritten by Mr. H. C. Fanshawe, late secretary to the Government of the Panjab, and author of an excellent account of the imperial city of Delhi. The arrangement has been recast in accordance with the most recent railway developments, and the accounts of the most important places have been revised in the light of modern research.

The handbook in its present form thus furnishes a compendium of the most trustworthy information regarding the topography, races, antiquities, and modern history of the Empire. As might have been expected, there are in some places signs that the new material has been imperfectly assimilated with the old, and some errors, misprints, and omissions have escaped the attention of the latest editor. Thus, Sir Colin Campbell's force at the final relief of Lucknow, which consisted of seventeen battalions of infantry, twenty-nine squadrons of cavalry, and 134 guns, certainly aggregated more than 2000 men; the venerable error that the River Gumti, really the Gomati, "rich in cows," means "serpentine," should not have been repeated; the sportsman might have been warned that rifles carrying the army cartridges are rigidly excluded, and he should have been advised to supplement his Express rifle by a smaller bore, high-velocity weapon.

These, however, are trifling matters, and the introductory chapter which gives advice on expenses, clothing, food, sanitation, and camping represents the accumulated experience of many competent authorities, while the accounts of the great cities, their architecture and industries, the campaigns and battles, leave little to be desired. The maps and plans are numerous, and, as a rule, excellent. The present edition, while it will be indispensable to the tourist, will find a wider circle of readers among officers on Indian service and their friends at home who are interested in the country and its people. For ordinary people it will be a useful substitute for a collection of the more bulky books of reference, such as the imperial and provincial gazetteers and the departmental reports, which must be consulted by all serious students of the Indian Empire, its races, and their history.

ENGINEERING GEOLOGY.

Geology for Engineers. By Lieut.-Colonel R. F. Sorsbie, R.E. Pp. xxvii+423. (London: C. Griffin and Co., Ltd., 1911.) Price 10*s.* 6*d.* net.

ONE important engineering lesson from this book is the danger of working with unknown materials and of using unfamiliar terms. The book is a compilation, mainly from second-hand sources of information, half of which are out of date. The author has seldom discovered the recent original authorities. The work consists of two parts; the first 238 pages

summarise the rudiments of general geology; the special subject of the book is confined to the second section of 160 pages.

The first part is unduly long, and is so inaccurate and out of date that engineering students will be well advised to learn the elements of geology from a more trustworthy text-book. The author's petrological knowledge may be illustrated by the following examples. "Peridotite.—A name used for a basalt or dolerite rich in olivine, chiefly noticeable on their [*sic*] alteration into serpentine" (p. 111). Clay (p. 114) is said to have "very nearly the same composition as the mineral felspar." The Silurian greywackes are included on p. 281 in the crystalline schists. Oolite is described as composed of "egg-like granules." The definition of agglomerate omits the essential character of the size of the fragments. In the author's definition of conglomerate, puddingstone is based on the rounded form of the pebbles instead of on the induration of the rock. The trap-rocks are retained in reliance on authors who, in this respect, were conservative when they wrote in 1885. The table of rock characters on pp. 203 to 206 is useless and misleading.

The section on palæontology is better, as it is briefer; it is equally inaccurate. The author says that the Cœlenterata are characterised by "a distinct body-cavity," and he refers to Favosites, which he includes in the Hexacoralla, as having septa "in sixes." On an authority of 1889 he states (p. 153) that the Radiolaria "are rarely found fossil."

In the chapters on stratigraphy are included various tables of foreign formations. Those for Australia, New Zealand, and South Africa are quoted from Prestwich's "Geology" of 1886. They are only of historic value. The value of the information on British stratigraphy may be judged from the statement (p. 180) that the Calciferous sandstones are overlain by the Carboniferous limestone in the north of Scotland.

It may be claimed that the book should be judged by its second part, which is, however, no better than the first. It contains much useful information, but most of the authorities quoted are out of date, and inadequate knowledge of geology and geography has led the author into many mistakes. He assures us (pp 239–40) that in open and barren plains

"the construction of railways influences the rainful [*sic*] to a very great extent. Instead of continuous drought all along the Pacific railroad, rain now falls in refreshing abundance."

The authority quoted for this extinct belief is Humber's "Water Supply of Cities and Towns," published in 1876. This book is the author's most oft-quoted source of information on matters connected with rainfall. The rate of deep-sea sedimentation is adopted, at second hand, from "the late Mr. Tylor" (p. 383), though a later authority on this question is elsewhere referred to (p. 23) as "Mr. Murray." The author often refers to himself as the authority for his statements, and amongst other criteria of doubtful geological value, which he advances as a result of his own observations, is that "snakes are common on light soils."

AN EASTERN HORSE-BOOK.

The Faras-Nāma-e Rangīn; or, the Book of the Horse. By "Rangīn." Translated from the Urdu by Lieut.-Colonel D. C. Phillott. Pp. xx+85. (London: Bernard Quaritch, 1911.) Price 10s. 6d. net.

THE author of this treatise, who wrote under the *nom de plume* of "Rangīn," was, it appears, from the translator's introduction, one Sa'adat Yar Khan, whose birthplace was Delhi. After serving for some time in the cavalry of one or more of the native princes, he eventually became a recluse, during which period of his life he appears to have written the present and other works. He died in October, 1835. In the East the "Fars-Nāma" rapidly attained popularity, as is attested by the fact of its having passed through several editions; but we fear that the same good fortune is unlikely to attend the translation. Indeed, it is difficult to see to what class of readers it is likely to appeal in this country, although it is suggested by the translator that it may prove of service to officers of native cavalry in India. Personally, we should have thought a good English work on the management and disease of horses would have suited their purpose far better, except perhaps as regards native ideas of the "points" of a horse.

In the introduction, Colonel Phillott, after referring to the important part played by the horse in the history of civilisation in India, observes that no treatise on the subject would be complete without mention of the legends and myths connected with its origin. These differ markedly according as to whether they are derived from Moslem or Hindu sources, although, as is so often the case in similar matters in India, some of these show evident signs of a mixed origin. As "Rangin" was a Moslem, he naturally wrote from the point of view of his own creed, and the translator has accordingly considered it desirable to give an account of the Hindu belief on this subject. As bearing on the origin of the classical myth of Pegasus, it is interesting to note that "according to Hindu legends, the horse was created a flying animal, one that could fly and run, and no man or God could snare it. Indra wanted horses for his chariots, and requested the sage Salihotra to deprive the horses of their wings. Accordingly Salihotra, by his *yoga* or supernatural power, derived by his austerities, accomplished Indra's wish." Deprived of their power of making long journeys in the air in search of medicinal herbs, the horses asked Salihotra to write a book on their diseases, which he did, and in time the Sanskrit name of the writer came to mean, first veterinary science, and then a horse. To this day native cavalry regiments have their *salotris*.

In connection with native horses, Colonel Phillott mentions that

"Indian countrybreds will eat and thrive on food that would probably kill English horses. In the Persian Gulf and elsewhere locusts, fish, and dates are regarded as legitimate food for horses and cattle; in Tibet the *tanghans* [horses] are given pig's blood and raw liver; and in the cold regions of Central Asia meat is regarded as a necessity for horses."

The actual text of the work must be passed over with the bare remark that "Rangīn" appears to have acquired a considerable knowledge of equine anatomy, both normal and pathological.

R. L.

ANIMAL PSYCHOLOGY.

La Nouvelle Psychologie Animale. By G. Bohn. Pp. ii+200. (Paris: F. Alcan, 1911.) Price 2.50 francs.

Clever Hans (the Horse of Mr. Van Osten): a Contribution to Experimental Animal and Human Psychology. By Oskar Pfungst. With an introduction by Prof. C. Stumpf. Translated from the German by Carl L. Hahn. With a prefatory note by J. R. Angell. Pp. vii+274. (New York: H. Holt and Co., 1911.) Price 1.50 dollars net.

DR. BOHN'S book is, as he himself states in his preface, the sequel and complement of an earlier work, "La Naissance de l'Intelligence," already reviewed in the pages of this journal. Its aim is to present a concise account of the development of psychism in the comparatively high forms of life represented by the class of anthropods and vertebrates respectively. The vital activities of the lower organisms are not neglected, however, and in the opening pages of the book one finds an excellent summary of the forms of explanation in terms of physical chemistry which Prof. Loeb has made famous under the names "tropisms" and "differential sensibility."

Dr. Bohn is Loeb's most distinguished follower, and he has defined the above-mentioned terms and indicated exactly to what forms of behaviour they are applicable with a brilliance even superior to that of the master himself. There is little doubt that the terms have been used with great laxity by many writers, particularly by those psychologists who are inclined to reject Prof. Loeb's views, and Dr. Bohn has done a real service to science in rendering them precise. Moreover, no one unhampered by preconceived theories will find fault, on the score of method, with Dr. Bohn for endeavouring to apply the law of parsimony as rigidly as possible, and only appealing to psychical factors after all the possibilities of physical and chemical explanation have been exhausted. Yet the result may not be entirely convincing, for although the observation of lowly forms of life encourages a mechanical system of explanation which the man of science is then stimulated to develop with ever-increasing complexity until it seems to give an approximately accurate account of even the higher forms of conscious behaviour of highly developed organisms, an investigator starting from the other end of the scale and acquiring an intimate knowledge of the nature and significance of consciousness in the life of man and the higher animals is likely to come to a very different conclusion as to the nature of, say, even protozoan activity. It seems, indeed, inevitable that there should be at least two widely diverging schools of thought in animal psychology, out of the conflict of the views of which truth will ultimately emerge, and that both are therefore necessary to the science.

Dr. Bohn passes on to a clear statement of the meaning and sphere of influence of "associative memory," and after a full discussion of the principal instincts of "articulated" animals, in which he shows that the word "instinct" explains nothing, and that the so-called instincts are aggregates of diverse activities which are far from exhibiting the exact adjustment to one another and to the environment with which they have been hitherto credited, he describes the principal experimental methods employed in the investigation of the psychical activity of the vertebrates, together with the more important results of these investigations. The little book is crammed with the most valuable material, set out in the most concise and attractive style, and one is glad to note that it has been crowned by the Academy of Moral and Political Sciences. No psychologist should omit to read it and re-read it.

"Clever Hans" was a Russian trotting horse, who took German music-hall audiences by storm by his remarkable power of working simple arithmetical sums, and answering other questions requiring a similar kind of reasoning ability. The owner, an elementary-school master, had taken him when young and taught him the rules of arithmetic according to the ordinary approved methods, and was himself convinced of his *bona fides*. An unofficially appointed Commission of psychological experts eventually proved conclusively, by experiments with the animal, that no true reasoning processes were performed, but that the horse, who tapped out its answers with its right foreleg, judged, by minimal muscular movements unconsciously performed by the questioner, when it had to stop. The questioner in asking the question was found to bend slightly forward, and then unconsciously straighten himself when the correct number of taps had been given. A slouch hat improved the "scores" by magnifying the amplitude of the movements, and when the questioner himself did not know the answer the horse was quite unable to give it. For further details of this most entrancing story, the reader is referred to the book itself.

WILLIAM BROWN.

OUR BOOK SHELF.

Vine-growing in England. By H. M. Tod. Pp. x+113. (London: Chatto and Windus, 1911.) Price 1s. net.

THE vision of the British householder sitting under his own vine seems capable of being realised from the perusal of Mr. Tod's interesting little treatise on vine-growing in England. The author examines the historical evidence connected with the vine in England and points out conclusively that its culture was once widespread not only in the country but also in and around London. Its decline no doubt was largely brought about by the dissolution of the monasteries, and it is also suggested that the enclosure of the land rendered many situations unsuitable for vineyards. The practical details for successful viticulture given in this book are admirable, and the author speaks with authority gained from a wide experience of vine growing in England, Europe, and South Africa.

Anyone anxious to start vines either in the open or against walls will find in the book before us almost every detail set out and every question answered. The site for the vineyard and the nature of the soil are

naturally of prime importance. The ground should slope both eastwards and southwards, and should be sheltered from south-west winds. The land should not be rich, but it must be well drained, and a point of interest in this connection is that vines can be grown for profit on poor land which is not suitable for corn.

Five years must elapse before the vines may be allowed to begin to bear, and the crops at first must be small, so that anyone who intends to lay down a vineyard will have to be prepared to wait for his profits. During the five years of waiting and after the vines will require much careful attention.

At the end of the book there is a chapter on wine, but it is a matter for regret that nothing of a practical nature is said about wine-making in England, though it is true that allusion is made to good wines which have been produced in this country, nor of the possibilities of profit of a wine industry. A list of the best vines for growing in England is given, with short accounts of the grapes and of the purposes for which they are most suitable.

Further Researches into Induced Cell-reproduction and Cancer. Consisting of papers by H. C. Ross, J. W. Cropper, and E. H. Ross. (The McFadden Researches.) Pp. 63. (London: John Murray, 1911.) Price 3s. 6d. net.

IN this little book Mr. H. C. Ross gives a number of papers by his colleagues and himself on the lines already laid down in the larger book which appeared earlier in the year. Much enthusiastic work is indicated, but it is difficult to realise that the booklet is intended as a serious contribution to science. The same criticisms that were levelled at the earlier production can be urged with equal or even greater cogency against this recent production, and it is really very difficult to avoid the conviction that the collaborators are gaily prancing about on dangerous ground the nature of which they very imperfectly comprehend. Thus the description of centrosomes and the familiar structure of erythrocytes is possibly a correct portrayal of appearances seen, but the conclusions as to the inducement of division in them are absolutely unconvincing. That there may be disruption is probable enough under the conditions employed, but the case for a true division in the sense in which this is ordinarily understood does not appear to have been made out in the examples they describe. There is, furthermore, an absence of anything like a cautious and critical attitude towards the surprising results alleged to have been obtained, and this of itself is enough to arouse scepticism in the mind of anyone who has had any experience of the pitfalls that lie in the path of all scientific investigation, and these pitfalls are especially numerous in the field of cytology.

The Adventures of Jack Rabbit. By Richard Kearton. With eight autochromes and numerous photographs direct from nature by Richard and Grace Kearton. Pp. xii+248. (London: Cassell and Co., Ltd., 1911.) Price 6s.

ALTHOUGH animal autobiographies do not appeal to ourselves, Mr. Kearton's attempt to describe the life and experiences of a wild rabbit will probably prove acceptable to a number of juvenile readers, especially during the Christmas holiday season; and if its perusal results in even a few of such readers taking seriously to nature-study the writer will doubtless have succeeded in his aim.

The feature of the work in which adults will be interested is formed by the illustrations, many of which, we think, are even above Mr. Kearton's high average; among these special attention may be directed to the eight "autochromes," by which we presume are meant colour-photographs. These are absolutely superb, whether they take the form of a clump of bluebells or a mass of blue speedwell, or whether they depict animals. Among those of the latter type, we are more particularly pleased with the portrait of a young fieldfare, and the picture of a thrush's nest and eggs amid their surroundings. It is, however, noteworthy in the case of the latter that the nest, eggs, and supporting stems are much more conspicuous than they would be in nature; this, we presume, being one of the unavoidable defects of colour-photography. The illustrations alone are quite sufficient to sell the book.

As regards the text, it may be remarked that it is unnecessary to refer to the thrush as the "song-thrush," a prefix, in this and other cases, being required only for species other than the typical one. It would also be better to call such animals as the water-rat and the field-mouse by their vernacular names instead of alluding to them as "voles." R. L.

The Natural History and Antiquities of Selborne. By Gilbert White. With illustrations in colour by G. E. Collins. Pp. viii+475. (London: Macmillan and Co., Ltd., 1911.) Price 10s. 6d. net.

SEVERAL years ago Mr. E. A. Martin, in "A Bibliography of Gilbert White," gave the results of an inquiry as to the number of editions which had been published of the famous "Natural History of Selborne." It appeared that up to the end of 1895 no fewer than seventy-three separate editions of the work had been issued since the original handsome quarto was published in 1789; and this number is now probably well above one hundred. There is apparently a constant demand for copies of Gilbert White's classic, and it is satisfactory that this should be so, for no more inspiring work on natural history has ever been written.

As good wine needs no bush, so White's "Selborne" requires no explanatory notes, and is best left to speak for itself. The present edition is free from editorial interference, its distinguishing characteristic being the twenty-four coloured plates representing outdoor life and scenes in and near Selborne. In the selection of subjects and their treatment the artist has shown sympathetic feeling and execution which are as rare as they are welcome. The result is a beautiful edition of a work which should be in every library. The text is ever fresh, and it would be difficult to produce more delightful illustrations to it than those painted by Mr. Collins.

A Primer of Astronomy. By Sir Robert Ball, F.R.S. Pp. viii+228+11 plates. (Cambridge University Press, 1911.) Price 1s. 6d. net.

THE first edition of this book was published in 1900, and there was a reprint in 1906. To the present issue two large charts of the northern and southern celestial hemispheres have been added, and also a chapter of forty-two pages, entitled "Celestial Objects." By means of these additions, the reader will be able easily to find his way about the heavens and identify objects and scenes of particular interest. It is a little to be regretted that the text has apparently been unaltered with the view of bringing it up to date; for though the fundamental facts relating to the solar and stellar systems remain much as they were when the book was written, a few statements, such as that, for instance, referring to Halley's comet as "due again about 1910," are—to say the least—anachronistic. We hope that the demand for the book will be great enough to justify the publication of a revised edition at no distant date.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Weather of 1911.

WITH reference to Sir Edward Fry's letter in NATURE of November 16, the following figures may be of interest.

We have some eighteen records of the temperature up to a height of 15 kilometres or more over the British Isles during the period of the hot weather, distributed over seven days. Excluding the records for Scotland in September, where the weather was not hot, the following departures from the mean are found:—

At 2·5 kilometres a temperature of	+5·5° C.
5·0 ,, ,, ,,	+2·5°
7·5 ,, ,, ,,	normal
10·0 ,, ,, ,,	normal
12·5 ,, ,, ,,	−7·0°
15·0 ,, ,, ,,	−5·0°

These figures show that the heat was confined to the lower strata. With anticyclonic weather, such as prevailed during the summer, it is usual to find a negative departure from the mean temperature above 12 km.; but the greatest departure from the mean is generally found at about 7·5 km., where, as a rule, we get +5° C. The +5° C. at 2·5 and the normal value at 7·5 are very unusual, but they are shown more or less in every record.

I agree with Dr. Shaw in thinking that the surface conditions are imposed upon us by the conditions that prevail above. From the total and partial correlation coefficients that I have obtained it seems to me that the pressure in the layers of air just under the isothermal, which may be taken as the pressure at 9 km., is the dominant factor in the distribution of pressure and temperature in the whole region of the atmosphere that has been explored, with the exception of the temperature near the ground, which in temperate latitudes is certainly more dependent upon the direction of the wind than upon anything else.

I do not altogether agree with Dr. Shaw in thinking that the changes of temperature at 9 km. are in any way due to changes in the direction of the wind at that height. It seems to me more likely that they are produced by rising or falling air, and that the vertical motion, and therefore the temperature, is the direct result of the variations of pressure.

Unfortunately, it is only on rare occasions that we can ascertain the rate and direction of the wind at great heights; but there is sufficient information to show us whether the temperature at any given height up to 15 or 20 km. is dependent upon the direction and rate of drift of the atmosphere as a whole, for the direction and distance of the falling place of the balloon supply the requisite information about the general drift on any particular occasion.

I hope shortly to tabulate the results of some 200 ascents, and ascertain what the connection, if any, may be.

Pyrton Hill, December 2. W. H. DINES.

The Interaction between Passing Ships.

THE statement made in NATURE of November 30, in the article on "The Interaction between Passing Ships," to the effect that no experiments have been made to test this interference in shallow water except those recently carried out at Teddington, needs some little qualification. A somewhat extensive set of experiments to test this, among other points, was carried out some two months ago at University College, Dundee. Screw-propelled models of various sizes, at distances apart up to 200 yards, were used in these experiments, the depth of water varying from 1·6 times the draught of the vessels to 12 times the draught. The results were of such apparent interest that they were communicated to the Admiralty, who arranged for the Teddington tests, of a more restricted nature, to be carried out on larger accurate scale models of the *Hawke* and *Olympic*. The results of the Dundee experiments have been for some weeks in the hands of one of the scientific societies, and it is hoped that they may soon be made public. A. H. GIBSON.

Engineering Department, University College, Dundee, December 2.

December Meteor-showers.

THE following meteor-showers become due during the period December 8–31:—

Epoch December 7, 17h. (G.M.T.), second order of magnitude. Principal maximum, December 8, 8h. 15m.; secondary maximum, December 8, 3h. 40m.

Epoch December 7, 22h. 30m., approximately sixth order of magnitude. Principal maximum, December 8, 1h. 30m.; secondary maximum, December 9, 1h. 40m.

Epoch December 13, 17h. 30m., approximately sixth order of magnitude. Principal maximum, December 12, 1h.; secondary maxima, December 11, 15h. 30m., and December 13, 11h.

Epoch December 13, 13h. 30m., thirteenth order of magnitude. Principal maximum, December 14, 22h. 5m.; secondary maxima, December 13, 21h. 5m., and December 16, 17h. 30m.

Epoch December 18, 2h. 30m., thirty-fifth order of magnitude. Principal maximum, December 18, 19h. 50m.; secondary maximum, December 19, 7h. 40m.

Epoch December 19, 10h., approximately fifteenth order of magnitude. Principal maximum, December 19, 13h. 50m.; secondary maximum, December 19, 17h. 15m.

Epoch December 22, 1h., fourth order of magnitude. Principal maximum, December 23, 0h. 40m.; secondary maximum, December 22, 21h. 30m.

Epoch December 23, 2h. 30m., ninth order of magnitude. Principal maximum, December 24, 6h. 30m.; secondary maximum, December 24, 18h. 15m.

Epoch December 25, 15h. 30m., approximately twentieth order of magnitude. Principal maximum, December 27, 13h. 50m.; secondary maximum, December 26, 15h.

Epoch December 30, 0h. 30m., approximately eighteenth order of magnitude. Principal maximum, December 31, 15h.; secondary maxima, December 31, 11h. 30m. and 16h. 15m.

There are reasons for believing that the total mass of a meteoric maximum may be considerably greater than is generally supposed. Such a mass of matter, in being brought to rest, must give rise to currents in the upper strata of the atmosphere, these currents very probably constituting what may be known as atmospheric depressions, inasmuch as a column of air if thus set in motion will weigh less than when undisturbed.

In December meteor-showers are more evenly distributed over the month than was the case in November; still, there are periods of special meteoric activity. The first of these, in intensity as well as in time, occurs on December 8; the second period, as regards intensity, is spread over the days December 22–24; while the third period, which is comparatively weak, falls between December 16 and 21. Shooting stars may be numerous on the night of December 31. JOHN R. HENRY.

Dublin, December 4.

The Inheritance of Mental Characters.

To Dr. Archdall Reid it is an "astounding thing" that I should imagine that Prof. Pearson could possibly agree with the interpretation I ventured to put upon his statement which Dr. Reid condemns as "void of all content" and "quite nonsensical." Dr. Reid evidently feels that my quotation from his attack upon Prof. Pearson was not quite fair, in that I omitted part of the context which he regards as essential. I apologise for an entirely unintentional and unforeseen cause of offence. As he has himself rectified this omission, I may, I presume, take it that all is *en évidence*

requisite to substantiate his wholesale and unqualified condemnation. May I follow Dr. Reid's example, and quote the whole of his quotation from Prof. Pearson?—"The sameness [in the appearance of moral and intellectual faculties as well as of physical characters][1] surely involves something additional. It involves a like heritage from parents. The degree of resemblance between children and parents for the physical characters in man may be applied to the degree of resemblance between children and parents for psychical characters. We inherit our parents' tempers, our parents' consciousness, shyness and ability, even as we inherit their stature, forearm, and span." This is the whole of the statement condemned.

I gather that Dr. Reid thinks as I do, that individuals vary in their capacity for developing various mental characters such as temper, skill in mathematics, music, and the various uses of language, and that such capacities may be, and very frequently are, inherited. Physical characters, different from "eye-colour or hair texture," but such as the capacity for a high or low degree of development of the muscles, bones, or internal organs, and including "stature, fore-arm, and span" to a considerable extent, also vary, and are very frequently inherited. Such characters, mental or physical, depend upon both inborn capacity and environment for development. Both capacity for development and environment vary, but only the capacity for development is inherited. Therefore I see nothing in Prof. Pearson's statement which in any way warrants Dr. Reid in saying that it is "utterly without significance, utterly void of all content," and "is so vague as to be quite nonsensical."

It is quite evident that Dr. Reid believes that Prof. Pearson holds that something beyond a capacity for development, which varies in individuals, is inherited. But there is nothing in the statement which implies anything of the kind, so it appears that Dr. Reid has issued an unqualified condemnation of something, with which he does not disagree, that Prof. Pearson has said, because he does not agree with what he believes Prof. Pearson thinks but has not said.

Now I know that there are people who claim the peculiar power of knowing what others think without using any of the usual physical means of communication. I, unfortunately, have no such power, and I take it that there are many who, like myself, are in a less fortunate position than the members of Dr. Reid's audience, in whose minds, he tells us, no misapprehension as to his meaning arose. The unfortunate persons who have no means, beyond reading what has been written, of knowing what Prof. Pearson and Dr. Reid think, are liable to be seriously misled by what Dr. Reid wrote in his paper. In his anxiety to emphasise the great capacity possessed by man for making acquirements, Dr. Reid runs perilously near to ignoring the facts that this general capacity is made up of many capacities, that all these capacities are variable, and that the variations are heritable. Is he so annoyed with Prof. Pearson for laying what he considers undue stress upon the heritable part of mental characters, that his criticism has gone beyond what he actually means? This is suggested by the manner in which he treats some of the physical characters in his paper. "Heads, hearts, lungs, livers, and the like are inborn and invariably present in parents, and offspring." Certainly, but the capacity for development varies in different individuals and is heritable. For instance, the heart of one individual will react to frequently repeated and violent exercise by increased muscular development, while in another it will give way and dilate under precisely similar conditions. So also with mental characters. No environment will make some men mathematicians, while others will become great mathematicians in a comparatively unfavourable environment. Much the same may be said of temper and similar characters.

After all, it is surely the heritable part—the variations in capacities for making acquirements in various directions—that really matters from the eugenic point of view.

Dr. Reid fears that "Prof. Pearson will pray ardently to be delivered from his friends." Unfortunately I have not the slightest claim to the friendship of Prof. Pearson. I neither fear nor hope with regard to his feelings as to what I have written about his statement. Even should he publish a repudiation of my interpretation in every detail, my position would be precisely what it is now—one of protest against a wholesale, unqualified, and one might almost say violent condemnation without any very evident reason, a condemnation likely to cause misunderstandings in a subject in which I am particularly interested. Such methods in controversy can serve no useful purpose.

Glasgow, December 2. CHARLES WALKER.

[1] Inserted to make the meaning of the context clear.

On the Occurrence of Brown Cannel Coal ("Kerosene Shale") with *Reinschia australis* in the Falkland Islands.

AMONGST an interesting exchange series of fossils sent to the National Museum, Melbourne, by the honorary curator of the Falkland Islands Museum, there is a specimen of "kerosene shale," which, on account of its deep brown colour, resinous lustre, and eminent conchoidal fracture, at once reminded me of the oil-bearing rock of Hartley, New South Wales. Upon slicing this specimen and comparing the structure with a slide of the Hartley rock in our museum cabinet it was evident that they were practically identical. The Falkland Islands specimen is formed, like that of the New South Wales rock, almost entirely of the small (?) thallophyte described by MM. Renault and Bertrand under the name of *Reinschia australis*, and believed by them to be nearly related to the Hydrodictyaceæ or Volvocineæ. The deep yellow coloured sacs are of the same dimensions in both examples. The specific gravities of the Falkland Islands and the New South Wales rocks were found to be approximately equal, being in both cases slightly more than 1. Prof. Liversidge gives that of the Hartley, New South Wales, specimen as 1·052. As Liversidge points out, this rock is scarcely a shale, since the shaly structure in hand-specimens is absent, but would be more aptly termed a "Cannel coal," or, as suggested by the Rev. W. B. Clarke, "brown cannel."

The Falkland Islands specimen was found near Hill Cove, West Falkland, and I have since been kindly furnished with further information as to its occurring a fair distance up several river valleys; so that this fact, together with its tolerably fresh appearance and only slightly water-worn surface, does not support the idea that it may be drifted from a great distance. There is considerable probability that deposits of this "kerosene shale" will eventually be found *in situ*, since the fact of a typical Glossopteris flora occurring in East Falkland has already been proved by J. Halle, the geologist to the Swedish Magellanic Expedition (*Geol. Mag.*, 1908, p. 265). To quote that author's own words:—"Fossils, principally leaves of Glossopteris, occur in many places, and it is evident that the whole southern part of East Falkland south of Wickham Heights belongs to the Gondwana system." Not only does the fossil flora correspond in this remarkable way with other areas of Gondwanaland, but amongst the brachiopods in the above collection several of the Spirifers bear a close resemblance to New South Wales species. FREDERICK CHAPMAN.

National Museum, Melbourne.

Optical Projection of Figures in Full Relief.

AT the recent Glasgow Exhibition an optical illusion was exhibited which showed very distinctly and daintily living human figures in full relief, standing upon a desk, on a scale of about 8 inches = 6 feet.

The production has caused much debate in private circles, and I write in the hope that someone may be able to inform me how it was produced.

I may say that the images were shown in ordinary electric light, and no optical apparatus of any description was visible.

Behind the figures the wall, which was at a distance of about 8 inches, was covered by what seemed an ordinary flowered tapestry.

The writer saw the same thing about seven years ago on the stage in Paris, and then, as now, the explanation eluded him and many of his friends. CURIOUS.

THE NEW BELL-PETTIGREW MUSEUM OF NATURAL HISTORY IN THE UNIVERSITY OF ST. ANDREWS.

THE comparatively few specimens of natural history in the olden time were stored in the Library of the University or in other rooms, and though Dr. McVicar, the first lecturer on the subject of natural history, commenced a new collection, about 1826, in the old dining hall of the United College, the results were small. It was not until 1838, the date of the foundation of the Literary and Philosophical Society, that Sir David Brewster pressed forward the formation of a museum for the University; indeed, this was one of the main aims of the society. Under the fostering care of the distinguished principal just mentioned, active progress was made, and by and by the Government provided a hall and adjoining rooms, with the necessary cases for the collections. The specimens have gradually accumulated since that date, and to such a degree after 1882 that the crowded condition of the shelves renders the museum at present mainly a store for the preservation rather than the exhibition of its contents. The need for extension was felt as early as 1884, when the architect of the Board of Works made plans for the extension of the museum on the present site—plans which met with the approval of everyone in the University. These included an aquarium and a marine laboratory on the ground floor, laboratories and class-rooms over them, whilst another large hall and accessory rooms formed an extension of the present museum to Butts Wynd, these filling up the north-western corner of the quadrangle. Unfortunately, though sympathetic, Mr. Gladstone's Government could not afford the funds, and ever since the condition has been clamant. It is true the University might have provided the funds, for it has built large additions in the shape of new class-rooms and a physical laboratory, and appropriated 5000*l.* of the Carnegie grant for endowing the chemical research laboratory, the munificent gift of Prof. Purdie. The department of zoology, however, had to wait. Thus it happened that, after the death of Prof. Pettigrew, his widow resolved to erect a memorial to him in the form of the spacious new museum at the Bute Medical Buildings, a site which in itself is full of reminiscences of the long-continued efforts of the deceased professor and a colleague—supported by the late Lord Bute and the medical graduates of the University—for securing two *anni medici* at St. Andrews, the other three years being intended for Dundee. Moreover, as he was a former custodian of the old museum, the gift of this memorial of Prof. Pettigrew is peculiarly appropriate.

Accordingly, plans of the new museum were prepared by Messrs. James Gillespie and Scott, architects, St. Andrews (to whom this article owes its illustrations), and the negotiations between Mrs. Pettigrew and the University Court were energetically carried out by my colleague, Prof. Musgrove, who, indeed, superintended the operations from first to last. Now the entire structure has been completed and furnished with electric light, and the cases (jointly provided by Mrs. Pettigrew and the University) have been erected in the great hall, where the celebration banquet was held last September. These cases are of the most modern type, viz. of iron, each wall-case carrying a door composed of a single sheet of plate-glass 9 feet by 5 feet, larger

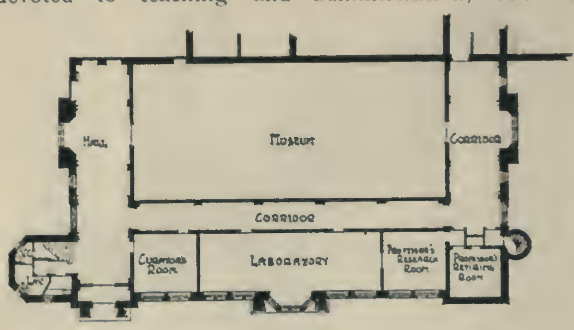
FIG. 1.—Front (West) of the New Bell-Pettigrew Museum.

sheets of glass occurring in the central cases on the floor.

The museum (Fig. 1) faces the west, close to the line of trees skirting the long walk of St. Mary's College, and is appended to the Bute Medical Buildings, from which access is gained by a fireproof door on each flat. Externally it has the botanic garden on three sides, and, when the approaches are widened, public access from Queen's Terrace and West Burn Lane will be facilitated; yet as regards position it is perhaps less in the current of visitors than the old museum in the United College.

The building (Fig. 1) is in the style of the English Renaissance, thus agreeing with the Bute Medical Buildings to which it is attached, and which were erected by Lord Bute, the same architects having prepared the plans. The main door faces the west and Queen's Gardens, and there are two stories. At each end of the roof is an open stonework canopy, the monogram of Prof. Pettigrew and his widow being engraved beneath.

The sunk floor contains long passages and spaces for storage and ventilation, and gives access to pipes and wires. The ground floor (Fig. 2) covers an area of about 130 feet by 75 feet, the entrance, already noted, being at the north-west corner, and leading to a vestibule, shut off by swinging and partially glazed doors, and a hall 65 feet long by 17 feet broad, with a spacious bow-window in the centre commanding views of the ancient halls of St. Mary's College and the principal's house, as well as the fine new Carnegie Library. At the eastern end of the hall are blank spaces which indicate where doors will in future open into a large lecture-theatre (not yet built). The ethnological collections will probably be placed in this hall. A stair leads from the north-western end of the hall to the upper floor, and in the spaces of the projecting tower are sinks and lavatories. The west front is devoted to teaching and administration, and is



-GROUND FLOOR PLAN-

FIG. 2.—For scale see Fig. 3.

separated by a long corridor from the main hall of the museum. It contains from north to south a curator's room, a class-room for practical zoology, 62 feet by 17 feet, a research-room, and a professor's room, near which is a turret-stair leading to the upper floor and to the roof. A corridor about 50 feet long and 17 feet broad extends along the southern face, with a spacious bow-window as in the north corridor; and as the botanical department adjoins and communicates with its eastern end, it is probable that this area will be devoted to the botanical collections.

The main hall of the museum on this floor is 90 feet long by 40 feet broad, and it passes upward to the roof, so that large skeletons, such as those of cetaceans, may be suspended in mid-air, rings and hooks being fixed to the beams, whilst a belt of wood below the cornice gives facilities for hanging pictures. The roof is doubly glazed, the inner layer being formed of muranese glass for diffusing the light, which is northern throughout, except at the lateral windows of the corridors. The floor is handsomely paved with marble mosaic, a special gift of Mrs. Pettigrew. This large hall will probably suffice for the mammals and birds, and, it may be, for the reptiles.

The upper floor (Fig. 3) has the same general area as the ground floor; but, since the great hall goes to the roof, only the western, northern, and southern galleries are available for cases. The spacious western gallery is about 122 feet long by 28 feet broad, and the inner borders of both it and the adjoining galleries are flanked by a series of Roman Doric columns, the effect of which is agreeable from all points of view. The entire upper floor is fireproof, being composed of iron and concrete with solid interlocked maple blocks. The north and south galleries are each about 70 feet long by 17 feet wide, a large bow-window occurring in the centre of each.

The extensive series of spirit preparations of the marine invertebrates (chiefly British), the collection of fishes and their eggs and early stages, will find space on the main part of this floor and along the northern corridor, but wall-cases are still required. Table-cases now in the old museum will occupy much of the floor. The southern corridor, which communicates by a door with the Bute Medical Buildings and is on a level with the department of geology, will probably contain the larger part of the geological and mineralogical specimens.

The munificence of Mrs. Pettigrew has thus solved the long-continued problem of museum accommodation, while at the same time it has produced a lasting memorial to a valued colleague, whose early researches on the muscular fibres and nerves of the mammalian heart, of the muscular fibres of the stomach and of the bladder, and whose ingenious ex-

-FIRST FLOOR PLAN-

FIG. 3.

periments on flight and animal locomotion are worthy of all praise. Indeed, as regards flight, it needed but a modern petrol engine to have raised Prof. Pettigrew's marvellous apparatus in the air, instead of flapping along the ground under the weight of a heavy steam-engine.

W. C. M.

THE PRESERVATION OF THE AFRICAN FAUNA AND ITS RELATION TO TROPICAL DISEASES.[1]

WHEN educated opinion in Europe, especially in England, could take stock of the ravages of British and Boer hunters who were exterminating the wonderful mammalian fauna of South Africa, a movement set in in the opposite direction for pleading with the British, German, French, and Belgian Governments to discourage or prohibit the destruction of wild life in their African territories. This desire to preserve the fascinating aspects of wild nature began to take a more acute shape in the last decade of the nineteenth century, and various African administrators, who were naturalists as well as sportsmen, induced their Governments to allow them to proclaim certain areas in Africa to be game reserves in which more or less complete protection was afforded to beasts, birds, and reptiles. The British

[1] "Further Correspondence Relating to the Preservation of Wild Animals in Africa." [Cd. 5775.] (H.M. Stationery Office.) Price 8½d.

Foreign Office took up the matter in the early 'nineties, and through Sir Clement Hill and others made arrangements with European nations for the institution of game regulations throughout Africa which might check the devastating raids of sportsmen. The movement was accentuated by a revelation of the wonders of the equatorial East African fauna, which really rivalled those of Cape Colony and Natal in the days of Roualeyn Gordon Cumming.

European opinion in Africa became sharply divided into two classes. There were the officials and some of the missionaries who, backed by the men of science of Europe, thought quite as much of the natural wonders of these African States, and regarded them as being an asset of equal importance with the profits which might be derived by the opening up of the country under the energy of European planters or capitalists. To some of us the lion, the elephant, the giraffe, the eland, kudu, sable antelope, and oryx were quite as important subjects of the new protectorates, and as deserving of reasonable protection, as the human inhabitants, and from an æsthetic point of view this argument was reasonable. On the other hand, the European immigrants and most of the natives clamoured for the right to destroy the wild game when and as they pleased. The Europeans, indeed, were seized by a kind of lust for blood which distracted them a good deal from the coffee, cotton, sugar cane, rubber, and tobacco planting which should have occupied most of their energies. They could not let an elephant or a buffalo, a rhinoceros or a giraffe, live within thirty miles of their station. The natives, forbidden to kill one another any longer, and unable to fight with the European, wished to devote their warlike enterprise to the destruction of big game, especially as the products of the chase were so marketable.

On the whole, the wishes of the official element, supported by the home Governments, prevailed. Game reserves were instituted, and to a great extent made valid by the application of laws. Highly-priced licences checked indiscriminate shooting on the part of Europeans, while the natives were seldom able to obtain arms of precision necessary to the rapid slaughter of game. So it was hoped in time a balance might be struck, and all the European possessions in Africa be studded with beautiful Government parks and paradises, in which would be preserved from extinction the wonderful fauna and the interesting flora of the most backward of the continents. In East Africa it seemed as if this policy of game preservation was a good one, even from a commercial point of view. The marvellous natural zoological gardens which it produced along the track of the Uganda railway brought every winter hundreds of well-to-do tourists, who spent much money in the country and amongst the natives. Then also it was thought that the African elephant might after all be harnessed to our industries, or allowed to breed as a provider of ivory; we might domesticate the eland and the bush-buck, and even do for the African buffalo what the European colonists of tropical Asia did for that of India several thousand years ago.

But at this stage—about three years ago—a new factor entered into the consideration of the problem. It was suspected that in many parts of Africa the existence of big game was actually prejudicial, and even dangerous, to the coexistence of the human race, black, white, or yellow. It seemed as though other creatures than man and monkeys must act as reservoirs of micro-organisms, especially trypanosomes, provocative of disease. Consequently, so long as they coexisted with man, the various species of tsetse-fly, of tick, and flea, would, even if infected human beings were isolated, have always the means of renewing their supplies of disease germs. In this way, epidemics of disease might be constantly renewed amongst man in Africa and his domestic animals. Certain game reserves, such as the elephant marsh in the southern part of Nyasaland, became peculiarly obnoxious to the European settlers round about. They stated that the herds of buffalo and other game that had increased and multiplied within this reserve were sources from which the tsetse-fly obtained at once its livelihood and its means of doing harm.

As regards the question of the relations between the tsetse-fly and the big game, it has been pointed out in a very authoritative manner by Sir Alfred Sharpe and other deservedly recognised authorities in the field that there are numerous districts in Africa almost entirely without big game which, nevertheless, swarm with tsetse-fly to such an extent that they are practically uninhabitable by man. In other words, that the existence of buffaloes, kudus, elands, zebras, &c., is *not* necessary to the perpetuation of the tsetse-fly, which apparently finds some other creature than these large mammals to supply it with the blood nutriment it requires or desires. Consequently, this argument does not hold as a justification for the extirpation of big game. Moreover, in many parts of West Africa where disease-conveying species of tsetse (Glossina) exist, there is very little big game. But within the last twelve months or so it has been proved conclusively by the biologists at work in Uganda that the large antelopes of that country are the hosts of dangerous trypanosomes, amongst others, of the trypanosome which causes sleeping sickness; and that if this terrible malady is to be extirpated from the Uganda Protectorate, practically all the larger antelopes must go; or at any rate, that their extirpation must be carried out rigorously in those well-wooded regions close to water inhabited by the dangerous *Glossina palpalis*.

Such discoveries, of course, have given great encouragement to that party among us specially represented by pioneers and colonists on the spot, eager for the unlimited destruction of wild life. There is, indeed, need for a wise administration of the law in this respect, and for the Colonial Office to obtain and to act on the most careful scientific advice. The same people that wish no check to be put on their blood-lust in regard to the destruction of rhinoceroses, of giraffes, of buffaloes and elephants, are equally eager to shoot all striking or beautiful birds, especially the various forms of white heron (egret) and crane—notably the crowned crane. Now it has been shown that certain forms of heron, especially the white ones, live almost entirely on insects and ticks, pursuing them by the waterside and attaching themselves to herds of domestic cattle or wild game, whom they relieve of their parasites and of the infesting flies. Similarly, crowned cranes, besides being very beautiful, are in every way the friend of man. They live chiefly on grasshoppers and locusts, they eat nothing that is of any value to man, and they are constantly at work destroying his enemies. In many regions of Africa the giraffe, the oryx, the elephant, rhinoceros, zebra, &c., are not in a position to be harbourers of trypanosomes, or if they are, these regions are entirely free from tsetse-flies.

The whole question is so important to the world in general, both for the extirpation of disease and the preservation of beauty and interest in fauna and flora, that it would be well to hold a Brussels Conference once in five years to discuss these questions, in regard to the destruction of harmful insects and the preservation or destruction of birds and beasts.

H. H. JOHNSTON.

CONCERNING CRUSTACEANS.[1]

THIS is a good instance of a sound type of book, one in which the specialist seeks to interest accessible outsiders in the particular class of animals to which he has devoted himself. It sometimes happens, indeed, that the specialist, forgetful that there was a time when even he knew nothing of his "ology," writes what no one outside the cult can pretend to enjoy or even to understand; or, having got narrowed down to a particular side of his subject, writes without perspective or any picturesqueness. But although Dr. Calman is one of the leading lights on crustaceans, and has by his researches made "carcinology" (we are instinctively sure that he hates the word) his lasting debtor, he condescends to write so that any fellow can understand, and he takes a broad view of his delightful subject. We say "delightful subject," not to depreciate the success which Dr. Calman has achieved in writing so interestingly about crustaceans, but because it must be admitted that there is considerable inequality in the literary value of the various classes of animals. Every zoologist for his own group, but there is no denying that crustaceans have more "points" about them than brachiopods, and more "habits" than crinoids.

FIG. 1.—A Spider-crab, *Maia squinado*, dressed in fragments of weeds. British (reduced). From "The Life of Crustacea."

Dr. Calman knows so much about crustaceans that he imbues even familiar themes with new interest. Thus the second introductory chapter, which gives an account of the lobster, as so many teachers of zoology do year after year, is enlivened by fresh touches. We read, for instance, of the prawn that was induced to put iron filings into its ears, with the result that its locomotion was seriously disturbed whenever a strong electro-magnet was brought into its vicinity. We are told, apropos of colour, that living lobsters are occasionally found of a brilliant red colour—ready boiled as it were. An account of the lobster's habits of food-testing, quoted from Dr. H. C. Williamson, strikes us as a fine piece of natural history. It seems, by the way, an unnecessary condescension to the laity to go on speaking of the gizzard as a stomach—a term which, as the author knows so well, is doubly misleading.

Helped by the excellent illustrations, the reader may, with a little care, get from the third chapter a grip of the somewhat intricate classification of the fairy-shrimps, water-fleas, carp-lice, barnacles, opossum-shrimps, wood-lice, sand-hoppers, prawns, squillas, lobsters, crabs, &c., that are all included under the title Crustacea. In the next chapter, which deals with life-histories, the author is careful to point out that while the occurrence of a nauplius larva in the life-history of, let us say, a branchiopod, a copepod, an ostracod, a barnacle, and a penæid prawn is strongly suggestive of the evolution-idea, there is no reason to entertain the idea that there ever was an ancestral type like a nauplius, or that any ancestors of the shore-crab resembled, even remotely, the zoëa stage with which the life-history of the individual now begins.

A great part of the book is devoted to a consideration of crustaceans in relation to their habitats, a mode of treatment which lays emphasis on adaptations. We are taken first to the sea-shore, where the "shifts for a living" are so numerous and varied. We read of symmetrical hermit-crabs in water-logged bamboo-stems; of crabs that masked themselves with seaweeds, and when placed in an aquarium among sponges picked off the weeds and put on sponge; of Prof. Garstang's observations on the breathing of Corystes when buried in the sand, of the ocypods that make a buzzing or hissing sound with their stridulating organ, perhaps, as Dr. Alcock suggested, to warn intruders that the burrow is already occupied; of the extraordinary protective resemblance of Huenia; of the bewildering variety of colour and colour pattern in Hippolyte; and so on through a wealth of fascinating illustrations. We are taken next to the deep sea, and the adaptations of long, stilt-like legs, of highly developed tactile organs, and the like are discussed. The discussion of luminescence is commendably cautious. Of a recently described case of certain deep-sea prawns which have photophores

FIG. 2.—A Deep-sea Hermit-crab, *Parapagurus pilosimanus*, sheltered by a colony of Epizoanthus. From deep water off the west of Ireland (slightly reduced). From "The Life of Crustacea."

[1] "The Life of Crustacea." By Dr. W. T. Calman. Pp. xvi+289. (London: Methuen and Co. Ltd., 1911.) Price 6s.

placed so as to illuminate the interior of the gill cavities, Dr. Calman well says: "What function they can discharge in this position seems beyond conjecture." It is very interesting also to read of *Platycuma holti*, which seems to feed on the deep-sea ooze, that it has a coiled food-canal, a very rare condition in Crustacea. Another kind of interest attaches to the occurrence of some old-fashioned types, such as the Eryonidea, in the great abysses. In an equally instructive manner the author deals with the crustaceans of the surface of the sea, of the fresh waters, and of the dry land.

A chapter on crustaceans as parasites and messmates is full of quaint things; we read of a little crab, *Hapalocarcinus marsupialis*, in which the female allows herself to be imprisoned within a cage or "gall" of living coral; of *Melia tesselata*, which carries a sea-anemone in each claw and uses it as a living weapon; and of the extraordinary life-histories of some of the parasitic forms. The contact of crustaceans with human life is illustrated by the palatable lobsters and crabs, shrimps and prawns, by the part which minute forms play in the economy of the sea, by the unique case of the species of Cyclops which is the intermediate host of the guinea-worm, and by borers like the gribble. A short account of Crustacea in the past completes the book, apart from useful appendices on collecting and on literature.

In every respect Dr. Calman's book is a success; it is as instructive as it is interesting, as careful as it is picturesque. It is an admirable introduction not merely to Crustacea but to natural history. In connection with a second edition, we venture to suggest that the author should consider the advisability of adding another twenty pages with tables helping the student to identify the commoner British forms. This seems all the more feasible when we notice the numerous excellent illustrations of British forms with which the book is already provided. But in the meantime we offer the author our congratulations.

THE NUTRITIONAL VALUE OF INDIVIDUAL PROTEINS.

NOW that the composition of the various foodstuffs is becoming better known, physiologists can apply themselves with renewed vigour and greater success to the problem of the part which each plays in nutrition. In this relationship most interest attaches to the proteins, and it is with this important class of substances that Dr. Osborne and Dr. Mendel have commenced what promises to be a most valuable series of researches.[1] It has long been known that gelatin is an insufficient food, and this fits in with the absence of certain molecular groupings (tyrosine and tryptophane) from its composition. More recent experiments have shown that other "imperfect" proteins—for instance, the zein of maize—are also imperfect from the nutritional point of view. There are, however, great difficulties in carrying out investigations on the effect of administering the necessary nitrogen in the shape of a single protein. In order to eliminate individual differences in animals, the experiments must be numerous; but perhaps the greatest drawback of all is the fact that a monotonous diet in itself produces distaste for food, so that the experiment is usually brought to an end by the animals refusing to take what is offered them after a comparatively short period of time.

In the present experiments rats were selected as the object of attack; they can be utilised in large numbers, and, being small animals, a comparatively limited supply of the purified protein will last a long time. Whether the results obtained are applicable in all details to other animals, man included, one feels a little chary in deciding, the proverbial association of mice and men being hardly sufficient grounds for supposing that men and rats are exactly similar in metabolic habits. The rat's span of life is much shorter than that of the larger animals, its first year corresponding roughly to the first thirty years of a man's life.

The two American physiologists mentioned have, however, been remarkably successful in avoiding the bad effects of a monotonous diet; but whether this was due to luck or to certain precautions they took is not quite clear from their publication. Whichever explanation is the correct one, they succeeded in keeping their animals alive for many months. They record numerous experiments in which casein formed the sole nitrogenous constituent of the dietary, and the animals exhibited no sign of ill-health or loss of weight. One animal lived for nearly a year on a diet in which the only protein given was the glutenin of wheat.

The authors direct attention to a most important point which is frequently neglected in such experiments. The metabolism of a growing animal is a different story from that of the adult. This is recognised empirically by practical physicians; it is recognised in the discussion which has taken place in the daily Press and elsewhere on the nutritive value of the different kinds of bread. But the reason for such a belief is still in the region of the unknown. We have no certain knowledge of what are the food constituents, no doubt present in quite small quantities, which are of special value in stimulating growth in young animals. Drs. Osborne and Mendel quite clearly see the problem, but so far they have not solved it. Casein, the protein selected for their most numerous experiments, is the principal protein of milk, the most important of the foods taken by the young; and yet they found that this dietary, given to young rats, maintained their weight, but led to little or no growth.

If we believe the exaggerated statements in the advertisements of foods consisting of this protein freed more or less completely from the other constituents of milk, we should be led to think them extremely valuable substitutes for the untreated article. Practical experience has shown that this is not the case, and the careful experiments which have prompted these remarks have the most important practical outcome in showing the danger of tampering with this essential article in the dietary of infants. Any attempt to "purify" it by removing constituents which are quite as important as the protein, and may be, from the health and growth point of view, even more important, is fraught with peril to the public.

W. D. H.

[1] "Feeding Experiments with Isolated Food Substances." By T. B. Osborne and Lafayette B. Mendel, with the cooperation of Edna L. Ferry. Pp. 53. (Published by the Carnegie Institution of Washington, 1911.)

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on November 30, when the report of the council was read and Sir Archibald Geikie delivered his presidential address. In the evening the anniversary dinner was given in the Hotel Metropole, and the speakers included Lord Justice Buckley, who proposed the toast of the Royal Society, Lord Alverstone (Lord Chief Justice), the Lord Mayor, and Dr. A. W. Ward (president of the British Academy).

In response to an appeal from the council for funds for the construction of additional buildings for ad-

ministrative and other purposes, that are required to meet the rapid extension of the work of the National Physical Laboratory, and for alterations needed to enable the testing work now carried on at Kew to be removed to Bushy, the Treasury has signified "that in addition to the sum of 5000*l.* inserted in the Estimates for the current year, My Lords will be prepared to ask Parliament to vote two further instalments of the same amount in 1912–13 and 1913–14, on the understanding that the whole scheme will be completed with this assistance." Plans for the buildings have accordingly been prepared, and their erection will be proceeded with at an early date.

At the request of the council, the Admiralty placed the services of H.M.S. *Encounter* at the disposal of the observers sent out by the Joint Permanent Eclipse Committee to observe the solar eclipse of April 28, 1911, and Captain Colomb and his officers and men rendered very efficient assistance to the work. The weather conditions were not very favourable, and two minutes of the 217 seconds of totality were lost. Under these adverse conditions one fairly good photograph was secured by the 3-foot coronograph with the Abney 4-inch lens of 33 inches focal length. With the short focus prismatic camera the whole hydrogen series from H_α to H_2 was secured at the beginning of the second "flash," and, although not adding much to previous knowledge, this is the first time H_α has been photographed at an eclipse.

Satisfaction was expressed by the council at the consent of Sir Joseph Larmor to be nominated for the office of senior secretary of the society for another year in view of the detailed preparations for the celebration of the society's 250th anniversary next year. A minute of the council states that "it is desirable that the secretaries be not so re-elected as to hold office for a period exceeding ten successive years," and under this rule Sir Joseph Larmor would in the ordinary course have retired on November 30. The council expressed the opinion, however, that on account of the celebration next year it would be detrimental to lose the advantage of the senior secretary's long experience and intimate knowledge of the work of the society, while at the same time the task of his successor would be made unduly onerous. This opinion was confirmed by the re-election of Sir Joseph Larmor as secretary at the anniversary meeting on November 30.

After referring to the losses by death which the society had suffered during the past year, the president directed attention to some points in the council's report not mentioned above and to the scientific work of the medallists. Subjoined are some extracts from the address :—

Presidential Address.

In my address last year I adverted to the history of seismological observation in this country and to the part taken in the development of this branch of observational science by our associate, Dr. Milne. I expressed the hope that means might be found to place his important service on a more permanent footing, with an enlarged staff and more generous financial aid. Though no important advance has yet been made towards the realisation of this hope, the subject has not been lost sight of, and at least one useful step has been taken in the more complete equipment of Eskdalemuir Observatory as a seismological station. There are now installed there the complete Galitzin apparatus and the twin Milne apparatus, which record photographically, and also the Wiechert and the Omori instruments, the observations of which are recorded on smoked paper. To Prof. Schuster we are indebted for his generosity in presenting the Galitzin apparatus. The various instruments, when completely put into working order, will supply valuable material for a comparison of results, and will provide an important addition to the network of seismological stations in this country. The addition of this seismological work to the other duties of the superintendent of the Eskdalemuir Observatory has shown that an increase of the staff under his supervision is imperatively required. The Gassiot Committee, after a full consideration of the subject, has recommended that a grant in aid for a limited period should be made by the Royal Society, and the council, approving of the proposal, has granted a sum of 450*l.* for the purpose of supplying an additional observer for two years, after which some other more permanent arrangement must be provided. In the meantime, the council has been gratified by the gift of 200*l.* from Mr. Matthew Gray for the purpose of assisting the progress of seismology at Eskdalemuir.

Fellows are aware that for many years past the society has been conducting researches into the cause and prophylactic treatment of tropical diseases, and that these researches are still in progress. Much information has been collected; and it is satisfactory to know that, since steps have been taken to remove the native population from the fly-belts, the areas affected by one of the most terrible of these maladies, sleeping sickness, have been considerably restricted. But much remains to be accomplished before the knowledge of the subject can be made as complete as it should be. As will be seen from the report of the council, the investigation is now about to be extended far beyond the bounds originally contemplated. It has been plausibly suggested that sleeping sickness may be transmitted from other sources than infected human beings, and the question arises whether the wild animals of tropical Africa may possibly supply the trypanosomes of that disease. Accordingly, at the request of the Colonial Office, the Royal Society has organised and despatched a new commission, under the directorship of Sir David Bruce, for the purpose of studying on the spot what may be the relation of the native fauna of Nyasaland and other parts of Africa to the spread of human trypanosomiasis, and what trypanosome diseases may affect the domestic animals of that region. The composition of the staff has been carefully considered with a view to secure adequate attention to each of the various branches of investigation that are embraced in the wide inquiry which is projected. It is interesting to know that Lady Bruce, who has all along been one of the most efficient observers in Africa, again accompanies her husband on this fresh expedition. I may add that she is not the only lady engaged under our auspices in Africa; Miss Robertson, who has had considerable experience in the study of trypanosomes, has volunteered her services in Uganda, and is now at the Mpumu laboratory tracking the development and transmission of the organisms to which trypanosomiasis is due.

The "Catalogue of Scientific Literature for the Nineteenth Century," on which the committee of the Royal Society has now been engaged for more than fifty years, is speedily approaching completion. The material for the final part (1883–1900) of the general catalogue, which is classified under authors' names, has been collected and sorted, and is nearly ready to pass through the press. Of the subject-indexes of scientific papers for the nineteenth century, two volumes, pure mathematics and mechanics, have been published; and the index for physics, in two volumes, is well under way. While the committee does not claim perfection in detail for the classification of the subject-matter of those sciences, and while it is aware that the arrangement of so great a mass of material which must be condensed into small space will always be liable to technical criticism in details, it nevertheless believes that no person who in future shall set about a general investigation or an historical survey in any department of one of these sciences can afford to neglect consultation of this index. It was felt to be worth while by so great a man as Thomas Young, a hundred years ago, to devote a large amount of time to the compilation of a classified index of the literature of natural philosophy up to that date, when the achievement was just within the range of private enterprise. The immense volume of the scientific literature of the last century could have been digested only by some corporate organisation; and the whole scientific world has signified in advance its obligation to the committee of the society and to the generous benefactors who have assisted the society in the work when its own funds had been depleted by undertaking the continuation

of the same work in the twentieth century as the "International Catalogue of Scientific Literature."

Having gone to so much trouble and expense in the preparation of the materials for these subject-indexes, the society is naturally desirous to see that the results become accessible to the scientific public, for whose use the volumes are intended. All the funds which the Royal Society can possibly devote to this work are necessary for its completion; thus there can be no question of free exchange, as was the case with the earlier volumes, however much the Royal Society might desire it. But, as the fellows are already aware, the Cambridge University Press has consented to undertake the entire risk of printing and publication, and has agreed to sell the volumes at a very moderate price. We are informed that the volumes of the index already issued have, for some reason, not yet attracted the attention among universities and public libraries that was confidently anticipated. I have therefore thought it desirable to bring this matter to notice to-day.

On July 15 of next year the Royal Society will have lived for exactly two centuries and a half. Looking back upon this long career, and considering the friendly relations which the society has for generations maintained with the men of science in all quarters of the globe, the president and council have thought that the occasion will be one which ought not to be passed over in silence, but which deserves to be marked in some worthy way. They have accordingly decided to invite the chief universities, academies, scientific societies, and other institutions in this country, in our colonial dominions, and abroad, to send delegates hither to join with us in celebrating our 250th birthday. The invitations will be issued next month, so as to allow ample time for the selection and the arrangements of the delegates and for our own preparations here. Our patron, his Majesty the King, has been pleased to signify his appreciation of the importance of our proposed celebration. Though the details of the function have not yet been settled, it is thought that the first reception and welcoming of our guests should be held in our own rooms, which, with their portraits and other memorials of our past, will doubtless be of interest to the visitors. For the banquet, at which the fellows and their guests will dine together, we hope to enjoy the use of a large hall specially lent to us for the occasion. Considering the early association of the Royal Society with Gresham College and the City, we trust that some opportunity will be afforded to us of renewing that intercourse, and thus of allowing our delegates to partake of the well-known hospitality of London. There will doubtless be a good deal of private hospitality. Of course, every facility will be arranged for our guests to see public buildings, museums, libraries, and other objects of interest. At the end of the function in London, the delegates may not improbably be invited to visit the Universities of Oxford and Cambridge.

As a permanent memento of the occasion, the council has decided to reproduce in facsimile the pages of the charter-book, containing the signatures of the fellows from that of the founder, Charles II., down to the present day. This interesting volume is now in course of preparation at the Oxford University Press. It has also been arranged to issue a new edition of the society's "Record," in great part rewritten, closely revised, and brought up to date. This volume is also in progress.

MEDALLISTS, 1911.

THE COPLEY MEDAL.

The Copley medal is this year awarded to Sir George Howard Darwin, for his long series of researches on tidal theory, including its bearing on the physical constitution of the earth and on problems of evolution in the planetary system.

As regards the actual oceanic tides, he has perfected the method of harmonic analysis initiated by Lord Kelvin, and has greatly promoted its practical application by the invention of simplified methods of ascertaining the tidal constants of a port from the observations and of framing tide-tables. In another series of researches the tides of a solid planet of slightly viscous material are investigated, including the consequent secular changes in the motion of the planet and of the tide-generating satellite. He traced from this point of view the past history of the earth and moon, and was led to the now celebrated hypothesis that the latter body originated by fission from its primary when in a molten state.

He has further studied in great detail the classical problem as to the possible figures of equilibrium of a rotating mass of liquid and their respective stabilities, which has engaged in succession the attention of Maclaurin, Jacobi, Kelvin, and Poincaré. The difficult theory of a binary system composed of two liquid masses revolving in relative equilibrium, now known as Roche's problem, has been greatly developed and extended by him. Such investigations have, of course, an important bearing on the theory of the evolution of the earth-moon system already referred to.

The above is a mere summary of the main lines of Sir George Darwin's activity. There are, in addition, a number of highly important memoirs on more or less cognate subjects. For example, in dealing with the question as to the degree of rigidity of the earth as it now exists, he has treated it from various points of view; he has considered the theory of the long-period tides, and the stresses produced in the interior by the weight of continents and mountain chains. Mention should also be made of remarkable papers on the history of meteoric swarms, and (in the domain of the more classical astronomy) on periodic orbits.

ROYAL MEDALS.

The assent of his Majesty the King has been signified to the following awards of the two Royal medals:—

The Royal medal on the physical side was assigned to Prof. George Chrystal, of Edinburgh University, on account of his contributions to mathematical and physical science, especially, of late years, to the study of seiches on lakes. Conspicuous in his early years as one of Clerk Maxwell's principal lieutenants, it is to him that we owe the experimental proof of the extreme precision of Ohm's law of electric conduction (Brit. Assoc. Report, 1876). His memoir on the differential telephone (Trans. Roy. Soc. Edin., 1880) was a notable early extension of the theory and practice of Maxwell's principles as regards inductances, now become more familiar when power transmission, as well as telephonic intercourse, proceeds by use of alternating currents. His duties as a teacher of mathematics led to the "Treatise on Algebra," which, besides being a book of original vein, was the earliest systematic exposition in our language of the more rigorous methods demanded in recent times in algebraic analysis. But this purely mental discipline, and its continuation in various memoirs on abstract mathematics, could not wholly occupy a mind trained originally in the school of physical science. Of late years Prof. Chrystal had been engaged with great success in a most interesting subject of research, in the theory and the observation of the free persisting oscillations of level in lakes, first observed and analysed by Forel on the Lake of Geneva.

At the moment when the council was adjudicating this medal it was unaware that the illustrious mathematician at Edinburgh was then lying on his death-bed. He had been in failing health for some time, but the latest news was more favourable. The end came, however, before he could learn that a Royal medal had been assigned to him. In these circumstances it was felt that the award should not be cancelled, but that the medal should be transmitted to his family as a visible token of the admiration with which the Royal Society regards his life-work. On appealing for the sanction of the Royal donor of the medal, his Majesty was pleased to approve of our proposal, and to add an expression of his condolence: "The King trusts that you will be so good as to convey to the family the assurance of his Majesty's sincere sympathy in the terrible loss that they have sustained, through which so distinguished a career has been brought to a close." Those who had personal acquaintance with Prof. Chrystal mourn the extinction of a life full of charm and brightness.

The Royal medal on the biological side has been awarded to William Maddock Bayliss, F.R.S. During the last twenty-five years the part taken by Dr. Bayliss in the advancement of physiology has perhaps been unequalled by any other physiologist in this country. His work has ranged over a wide field. In his earlier papers dealing with the electrical phenomena associated with the excita-

tory state in glands and contractile tissues, he brought forward results which were, at the time, entirely novel, and have formed the basis of all subsequent investigations. His paper with Starling on the electrical phenomena of the mammalian heart was the first to give the correct form of the normal variation, as confirmed by later investigations with the string galvanometer.

Another subject which has engaged his attention at intervals during the whole of his career has been the question of the innervation of the blood-vessels. A third group of researches is represented by those on the innervation, intrinsic and extrinsic, of the intestines. A fourth group of papers deals with the mechanism of the pancreatic secretion. These researches, which by themselves would be sufficient to justify the award of the Royal medal, were also carried out in partnership with his colleague, Prof. Starling. The discovery of secretin afforded for the first time a convenient and easy method of obtaining pancreatic juice in large quantities. The investigation of the properties of pancreatic juice and of the activation of its chief proteolytic ferment by another ferment, enterokinase, secreted by the intestinal mucous membrane, has led Bayliss to a further series of researches on the mode of action of enzymes and on the closely related questions with regard to the nature of colloidal solutions. The value of this work has been universally recognised.

Davy Medal.

The Davy medal is this year assigned to Prof. Henry Edward Armstrong, F.R.S., on account of his researches in organic and in general chemistry.

For many years he has been engaged, partly alone and partly in collaboration with many of his students and others, in the investigation of a number of important problems in organic chemistry. His series of memoirs on the terpenes, on the chemical and physical relationships which obtain among the isomerides of the naphthalene and the benzene series, and on physiological chemistry, have established a strong claim for recognition.

In addition to his direct scientific work, he has taken an active part in the discussion and criticism of current theories, and has put forward views on chemical change and on other subjects which have suggested fruitful lines of inquiry. Gifted with a scientific imagination, interested in the work of others, exceptionally well informed as to recent progress, not only in chemistry, but also in cognate sciences, he has had a stimulating effect on his fellow chemists, and has done much to bring together for their mutual benefit the workers in different fields.

Hughes Medal.

The Hughes medal has been assigned to Charles Thomson Rees Wilson, F.R.S., in recognition of the value of his contributions to our knowledge of the nuclei produced in dust-free gases, and of his investigations upon the nature and properties of ions in gases. Following up the well-known work of Aitken on dust nuclei, Mr. Wilson devised a special apparatus for producing a sudden cooling of a gas saturated with water vapour. After completely freeing the gas from dust particles he found that water was condensed on a few nuclei after an expansion of volume greater than 1·25, and that a dense cloud was formed when it exceeded 1·38. This work was in progress at the time of the discovery of X-rays. He immediately tried the effect of passing this radiation through the gas in the expansion chamber, and found that a dense cloud of fine water drops was produced for all expansions greater than 1·25. In this way he showed that the charged ions produced in gases by the X-rays became nuclei for the condensation of water at a definite supersaturation.

This condensation property of ions, discovered by Wilson, was utilised by Sir J. J. Thomson to count the number of ions present, and to determine that fundamental electrical unit, the charge carried by an ion in gases. Recently Mr. Wilson has perfected the expansion method to detect the effects of individual α and β particles.

A further study by this extraordinarily delicate method promises not only to afford a practical means of counting the α and β particles in a gas, but also to throw light upon some of the more important and recondite effects produced by the passage of different types of ionising radiation.

NOTES.

The Birstall Urban District Council initiated about twelve months ago a movement to commemorate, in his native town of Birstall, the distinguished philosopher and man of science Dr. Joseph Priestley, the discoverer of oxygen. The town of Birstall, which is the birthplace of other distinguished men and women, including Margetson, Primate of Ireland, Curwen, of tonic sol-fa fame, and others, was a fitting birthplace for a man of clear vision, cool thought, and high speculation such as Priestley. Backed by the high Adwalton Moor on the north and north-east, the Priestley homestead of Fieldhead looked out on a fine panorama, with Castle Hill, Huddersfield, and smaller Yorkshire towns rising high on either side of Batley and the stretch beyond. For many years the inhabitants of Birstall have been desirous that something should be done to express by permanent memorial the town's pride in her illustrious son, and the present movement is the outcome. It is proposed to erect a life-size figure of Dr. Priestley on a handsome pedestal, to be placed in the most prominent position in the large market-place. For this purpose 1000*l.* is required, and already about 450*l.* has been secured; but the local committee is now desirous of appealing to a wider public, and especially to all interested in the various branches of chemistry. The London City and Midland Bank, Batley, are the bankers of the "Priestley" Fund.

On Tuesday, December 5, a deputation of aëroplane and aëromotor manufacturers, with representatives from the Royal Aëro Club and the Aëronautical Society, waited on Colonel Seely in connection with the proposed Military Aëroplane Competition. The deputation, which was introduced by Sir Chas. D. Rose, asked for immediate conditional orders so that manufacturers might have some guarantee of return for the outlay necessary for entering the competition, pointing out that they, representing a struggling and unsupported industry, were asked to compete against flourishing and State-aided industries from abroad in an international competition. Colonel Seely in his reply stated that, with the exception of the principal prize, not all the prizes would be open to the world, and intimated that some orders would be given before the competition. He further said that the answer to the question whether orders would be given for all machines passing the tests would be found in the specification for machines and the rules of the competition, which would be published in about a fortnight's time, and that it was the intention that aëroplanes selected for Government service, which would not be confined to one type, should be manufactured in this country by the civil industry and not in Government factories. He intimated that large orders would be given for the chosen machines, and that if the consensus of the manufacturers' opinion was against holding the competition early in the summer (June) he would see that recommendations to that effect were made in the proper quarter. The deputation subsequently decided to forward a resolution that it would be in the best interests of the competition to postpone it until September.

An interesting demonstration in connection with electro-chemical culture will be given on Saturday, December 9, at 4 o'clock, at the Royal Botanic Society's Gardens in Regent's Park, when practical demonstrations will be made with an electric apparatus to show the effect of electricity on the germination of seeds.

The Physical Society's annual exhibition, which is to be held on Tuesday, December 19, at the Imperial College of Science, South Kensington, will be open in both the

afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.). The Hon. R. J. Strutt, F.R.S., will give a discourse at 4.30, and again at 8 p.m., on "Electric Discharge and the Luminosity which survives it." About thirty firms will exhibit apparatus.

WE regret to see announced the death, on November 23, of Mr. Arthur Cottam, at seventy-five years of age. Employed as an official in a Government department during a great part of his life, he was an enthusiastic amateur astronomer. He was elected a fellow of the Royal Astronomical Society so far back as 1862, and was one of the original members of the British Astronomical Association, being its secretary from its foundation in 1890 to 1892, when he resigned owing to increasing pressure of official duties. In 1898 he became director of the Jupiter section of the association, an office which he retained until 1903. Mr. Cottam is best known by an excellent star atlas, "Charts of the Constellations," which he published in 1889. These charts show all stars down to about the 6·5 magnitude, from the North Pole to between 35° and 40° of south declination, for the epoch 1890. Originally projected as companions to Webb's "Celestial Objects" and Smyth's "Bedford Catalogue," their scope was considerably enlarged, and they show many original features. Each map usually gives one constellation only with the region around it, and the brighter stars have much larger discs than usually given, so that the leading stars in the maps are those which catch the eye by their brightness in the heavens.

IN *Die-Woche* of November 25 we find an article on the Middle European earthquake of November 16. It describes the districts which were most disturbed, the one most strongly shaken being that of the northern Alps. The central earthquake station in Strassburg places the origin to the south-east of Lake Constance. From time observations the epicentral area lies in 47 degrees north latitude and 10·30 east longitude. But before anything definite can be said as to this and other matters connected with earthquake, it is necessary to wait for reports from other stations. In the article reference is made to the geological character of the northern Alps and the Rhine Valley, the numerous faults which occur, and the relationship of these to tectonic earthquakes.

PROF. W. C. BRÖGGER (Christiania), Geh. Rath Prof. T. Curtius (Berlin), Prof. P. A. Guye (Geneva), and Geh. Regiersrung Rath Prof. H. Rubens (Berlin), have been elected honorary members of the Royal Institution. Dr. W. Bateson, F.R.S., has been appointed Fullerian professor of physiology for a term of three years. At a meeting of the managers of the institution on December 4 the following resolution was passed unanimously:—"That the managers offer their special thanks to the Fullerian professor of chemistry for his munificent gift to the institution in the decoration and furnishing of the lecture room, and at the same time they wish to express their high appreciation of the occasion upon which it has been made, namely, in commemoration of his having, on October 22, 1911, occupied the chair of chemistry as long as it was held by Faraday."

THE following are among the lecture arrangements at the Royal Institution before Easter:—Dr. P. Chalmers Mitchell, a Christmas course of six illustrated lectures on the childhood of animals, adapted to a juvenile auditory: (1) "Introductory"; (2) "The Duration of Youth"; (3) "Colours and Patterns of Young Animals"; (4) "Young Animals at Home"; (5) "The Feeding of Young Animals"; (6) "The Play of Young Animals." Dr. W. Bateson, six lectures on the study of genetics; Prof. E. G. Coker, two lectures on optical determination of stress and some applications to engineering problems; Dr. T. Rice Holmes, three lectures on ancient Britain; Prof. A. W. Bickerton, two lectures on the new astronomy; Prof. A. M. Worthington, two experimentally illustrated lectures on the phenomena of splashes; Mr. F. A. Dixey, two lectures on dimorphism in butterflies: (1) "Seasonal Dimorphism," (2) "Sexual Dimorphism"; the Rev. John Roscoe, two lectures on the Banyoro: a pastoral people of Uganda: (1) "The Milk Customs," (2) "Birth and Death Customs"; Sir J. J. Thomson, six lectures on molecular physics. The Friday evening meetings will commence on January 19, when Sir James Dewar will deliver a discourse on heat problems. Succeeding discourses will probably be given by Prof. Bertram Hopkinson, Dr. J. Mackenzie Davidson, Dr. J. A. Harker, the Rt. Hon. Sir John H. A. MacDonald, Mr. G. K. B. Elphinstone, Dr. W. J. S. Lockyer, Mr. F. Soddy, Prof. D'Arcy W. Thompson, Sir J. J. Thomson, and other gentlemen.

THE Lord Mayor will preside at the sixth annual meeting of the National League for Physical Education and Improvement, to be held at the Mansion House to-morrow, December 8, at 3.30 p.m. The meeting will be addressed by Sir Archibald Geikie, president of the Royal Society; the Lady St. Davids; Dr. Christopher Addison, M.P. (on legislation and public health); Prof. Bostock Hill, county medical officer of health for Warwickshire (on the organisation of a National Health Week); Mr. Henry Jephson, and others. Among those who have promised to attend are Sir Lauder Brunton, Sir John Tweedy, Sir Wiliam Church, Sir Edward Brabrook, Muriel Viscountess Helmsley, Lieut.-General Sir Robert Baden-Powell, Admiral the Hon. Sir E. Fremantle, and Archdeacon Sinclair.

A SPECIAL weights and measures committee of the Central Chamber of Agriculture recommended recently that agricultural produce should be sold by weight. It reported that suitable weights were the lb., the cental (100 lb.), and the short ton of 2000 lb. Dealing with this suggestion in a circular, which has been distributed, the Decimal Association points out that advocates of the metric system offer a solution of the difficulty by proposing that farmers should urge the compulsory introduction of the metric system into this country. Less disturbance would result from the adoption of the metric system than would follow the introduction of the cental and short ton, for the reason that the larger measures of the metric system differ but little from the cwt. and ton. The increase of the lb. by about 10 per cent. to make it equal to the half-kilo would lead to a metric cental of 110 lb. (100 metric pounds), and a ton of 2000 metric pounds equal to 2204 present lbs. Our Consul at Copenhagen reports that the Metric System Act, which will come into force next April, was passed by the Danish Upper and Lower Houses, in both of which the majority are agriculturists.

BY the authority of the Dominion Government, the director of the Canadian Meteorological Service has established a department of physics in connection with the Central Office at Toronto. Mr. John Patterson has been placed in charge of this new department; and it is proposed to carry on research work in atmospheric electricity, solar radiation, ionisation, and the exploration of the upper atmosphere. A kite station has been equipped near the magnetic observatory some fourteen miles from Toronto, and good results are being obtained. Since February last registering balloons carrying the Dines meteorograph have

been sent off with regularity on the international days, and of sixteen balloons liberated, eight have been returned to the Central Office with good records. In comparison with the results obtained in Europe, the percentage of successful ascents may be regarded as very encouraging. The heights reached have varied from 11·2 to 23·2 kilometres. The isothermal layer has been found at an average height of 13 kilometres. The lowest temperature recorded was −70° C. at 15 kilometres on July 5, and the highest altitude reached was 23·2 kilometres on September 9, when the lowest temperature, −55·5° C., was recorded at 14 kilometres.

THE premises of the Institute of Chemistry, the lease of which will expire shortly, and cannot be renewed, have become inadequate for the increasing activities of the institute. To carry on the work, the council of the institute requires new buildings, which should include more commodious meeting rooms, library, laboratories, examination rooms, and offices. It is proposed to begin the preparation of plans next year, and it is estimated that the necessary building and fittings will cost about 15,000*l*. An appeal has been made to fellows and associates of the institute, which has already resulted in the receipt of contributions and promises amounting to more than 8000*l*. With more than half of the required sum assured, it may be confidently hoped that the appeal will result in the completion of the necessary amount at an early date. It is gratifying to notice that the preliminary list of contributions includes the names of some of the great city companies and of business firms not directly connected with the institute. Contributions may be forwarded to the president, Dr. G. T. Beilby, F.R.S., at 30 Bloomsbury Square, London, W.C., or may be sent direct to the account of the Institute of Chemistry (Buildings Fund) with the London County and Westminster Bank, 214 High Holborn, London, W.C.

THE annual meeting of the American Association for the Advancement of Science will be held this year in Washington on December 27–30. The retiring president, Dr. A. A. Michelson, will, on the evening of December 27, introduce the new president, Dr. C. E. Bessey, of the University of Nebraska, and afterwards deliver his address on "Recent Progress in Spectroscopic Methods." On December 27 the presidential addresses in the sections will be:—the resins and their chemical relations to the terpenes, Mr. Frankforter; adaptation, Mr. Reighard; some current conceptions of the germ plasm, Mr. Harper. On December 28:—work of the electrical division of the Bureau of Standards, Mr. Rosa; aërial engineering, Mr. Rotch; the teaching of general courses in science, Mr. Hill. On December 29:—on the foundations of the theory of linear integral equations, Mr. Moore; the independence of the culture of the American Indian, Mr. Dixon; the cause of high prices, Mr. Burton. The presidents of the sections for the ensuing year are as follows:—A, Mathematics and Astronomy, E. B. Frost, Yerkes Observatory; B, Physics, R. A. Millikan, University of Chicago; C, Chemistry, F. K. Cameron, U.S. Department of Agriculture, Washington, D.C.; D, Mechanical Science and Engineering, C. S. Howe, Case School of Applied Science, Cleveland, Ohio; E, Geology and Geography, B. Shimek, State University of Iowa; F, Zoology, H. F. Nachtrieb, University of Minnesota; G, Botany, F. C. Newcombe, University of Michigan; H, Anthropology and Psychology, G. T. Ladd, Yale University; I, Social and Economic Science, J. Pease Norton, Yale University; K, Physiology and Experimental Medicine, W. T. Porter, Harvard Medical School, Boston; L, Education, E. L. Thorndike, Columbia University. Thirty scientific and other learned societies have indicated their intention to meet at Washington on the same dates in affiliation with the American Association for the Advancement of Science. The permanent secretary of the association is Dr. L. O. Howard, Smithsonian Institution, Washington, D.C.

THE twentieth report of the Board of Health on Leprosy in New South Wales for the year 1910 (dated July 31, 1911) states that nineteen lepers remained under detention at the lazaret, and that five new cases were reported in 1910. The histories of these new cases are detailed together with surveys of the white patients remaining under treatment. Nine excellent plates of the condition of some of the lepers are appended.

IN *The Quarterly Journal of Experimental Physiology* for October (iv., No. 3) Messrs. Vernon and Stolz discuss the influence of forced breathing and of oxygen on athletic performance. It is well known that several deep inspirations enable the breath to be held for a longer period than without this preliminary, but it is shown that to obtain this result the forced breathing should be continued for two or three minutes. An addition of oxygen much lengthens the period during which the breath can be held. Thus Mr. Vernon found that after six minutes of forced breathing of air, followed by four breaths of oxygen, he could hold his breath for no less than 8m. 13s.

IN *Himmel und Erde* for November (Jahrg. 24, Heft 2) Dr. E. W. Schmidt, under the title of "Die Panspermie-Hypothese," gives an account of the views of Arrhenius on the possible transference of living germs through interstellar space from one star or planet to another; Prof. Ficker continues his series of articles on bacteria as enemies and friends of man; and Dr. Emil Carthaus discusses the origin of pearls, and gives many interesting historical details concerning them.

IN a recently published pamphlet entitled "The Fight against Tuberculosis and the Death-rate from Phthisis" (Dulau and Co., pp. 35, price 1s. net), Prof. Karl Pearson criticises the evidence which has been advanced in favour of a belief that the prevalence of phthisis can be, or has been, diminished by measures intended to reduce the opportunities of infection. Prof. Pearson strongly urges the importance of some constitutional factor, and publishes diagrams which, in his opinion, render it difficult to suppose that the fall in the phthisis death-rate which has been observed in modern times can be attributed to increased segregation of the diseased, bettered environment, or changes in treatment. The pamphlet will repay perusal, although its style, which is more vigorous than urbane, is not likely to facilitate an impartial consideration of Prof. Pearson's views.

THE report of the Manchester Museum for 1910–11 contains plans and a view of the front elevation of the proposed new wing, part of which is now in course of construction, while the remainder is reserved for the future. It appears that in the original scheme for the natural history museum Egyptology and anthropology were not included; but during the last thirty years large collections in these subjects have accumulated, which require adequate accommodation, and it is for these that the new building is being erected. The cost of the whole scheme of extension is estimated at 10,000*l*., of which 5000*l*. has been given by Mr. Jesse Haworth, while 2825*l*. has been raised by public subscription. The general progress of the museum has been very satisfactory during the year, and the attendance at the courses of lectures fairly good.

IN the second part of the Transactions of the Bristol and Gloucestershire Archæological Society Miss M. L. Bazeley contributes an important paper on the relations of the Forest of Dean with the Crown during the twelfth and thirteenth centuries. She describes in detail the ancient boundaries of the forest, the animals found in it, and the periodical Royal visits for the purpose of sport. Fallow deer were abundant, with red deer and roes in smaller numbers. Wild boars seem to have been exceedingly numerous. On one occasion King John had twenty captured for use on the Feast of St. David at Westminster; twenty boars and sixty sows were sent to him for the Feast of the Nativity, and Henry III. had as many as a hundred for the Christmas dinner in 1254. These requisitions seem to have seriously reduced the supply. We hear of hunts of wolves and wild cats in 1281, when of the former we are told that they "as injurers of the venison frequently return for the venison and stay in the said wood, on account of the thickness thereof."

THE report of the Marine Biological Association of the West of Scotland for 1910 indicates that the work of that body has been carried on steadily during the period under review; and it may be noted that a special effort has been made to provide, in full efficiency, all the facilities for study and research available at Millport. A large number of visitors entered the museum and aquarium, the latter of which is steadily increasing in popularity.

IN the November issue of *The Zoologist* Dr. James Murie discusses the introduction of the American slipper-limpet (*Crepidula fornicata*) into this country, and its influence on oyster-culture in Kent and Essex. The mollusc appears to have been introduced into the estuary of the Crouch and other rivers on imported American oysters somewhere about 1880, and by 1893 had become comparatively abundant; it is now too firmly established to be eradicated. Its introduction has entailed considerable extra labour on oyster-beds, as the oysters have from time to time to be dredged and freed from the parasite, which adheres tightly to their shells. But this is not all, as this constant and excessive dredging causes the growing oysters to have broken or imperfectly formed margins to their valves, whereby their commercial value is lowered. Investigations with the view of mitigating the evil appear to be urgently required.

IN connection with the letter from Messrs. Puran Singh and S. Maulik in NATURE of November 23 on the nature of the light from fireflies, it may be mentioned that the subject has been recently discussed in vol. iii., No. 1, of the Annals of the Transvaal Museum by Mrs. A. B. Howard, who observes that this light is unique in being unaccompanied by perceptible heat, and is therefore produced at the least possible expenditure of energy. In the American species, on which the investigations were made, light is emitted by both sexes, although that of the flightless female is feebler than that of her partner. In the latter the light is produced by a pair of plates lying beneath the thin skin and filling the lower half of the fourth and fifth abdominal segments. These light-giving organs consist of an upper and a lower layer, of which the latter is composed of polygonal cells filled with coarse granules. Although the minute size of the structures renders investigation very difficult, it is considered probable that the light is due to the oxidation of some substance—very likely fatty—contained in the cells of the lower layer of the light-organs.

As those who have studied the subject are aware, there are features connected with "fairy rings" which are not immediately explicable. In the latest paper, which appears in *The Journal of Economic Biology* (vol. vi., No. 4), Miss J. S. Bayliss points out that it is not known how the fungus first infects the soil or why it grows in rings; but otherwise the paper provides acceptable explanations of observed features and experiments in connection with the ring growth of *Marasmius oreades*. Two zones are easily recognised, an inner dark green grass zone and a dead grass zone where the fungus is growing. Dr. Bayliss directs attention to another dark green zone on the outside that is particularly well developed in September. The action of the fungus is complicated, since it apparently produces a stimulating effect, as shown by the outer green zone, while it excretes a toxic substance leading to the complete destruction of the grass; subsequently it poisons the ground for its own development, and then decomposes into manure for the grass.

DURING the past few years various expeditions from the University of Chicago have secured from the fossil fields of northern Texas the largest and best collection of Permian vertebrate fossils in the world. During last summer an expedition from the University, under the direction of Prof. S. W. Williston, explored the Permian deposits of north-western New Mexico with valuable results. *Science* says that these Permian deposits, of small extent, in Rio Arriba County, were discovered more than thirty years ago, but have been neglected by explorers ever since, and their precise location even was unknown to geologists. As a result of Prof. Williston's excavations, numerous fossils have been shipped to the University, many of which are unknown to science. This collection includes six or seven new genera of reptiles and amphibians, one of which is represented by one of the most perfect skeletons, about 6 feet in length, ever found in any deposit in America.

To *Symons's Meteorological Magazine* for November Mr. F. W. Henkel contributes an interesting article entitled "Is the Zodiacal Light a Meteorological Phenomenon?" The author points out that a complete and satisfactory answer to the question cannot be given, and that our knowledge of the subject is but little greater than was possessed by the first discoverers. Even in recent times considerable confusion has existed between the phenomenon and the aurora. He refers to the various observations made since the time of Cassini, of Paris (about 1683), and to the descriptions of the counter-glow (at an angular distance of 180° from the sun) by Brorsen and others. One of the most recent theories of the latter phenomenon is that suggested by Mr. Innes in NATURE of June 16, 1910.

THE Weekly Weather Report issued by the Meteorological Office gives a summary of the temperature, rainfall, and bright sunshine for the several districts of the United Kingdom for the thirteen weeks ended December 2, which embraces the whole period of autumn. The mean temperature was generally below the average in Scotland, it was in good agreement with the average in Ireland, whilst in England an excess of temperature occurred for the most part. The range of temperature was unusually large, due chiefly to the exceptional heat in the recent abnormal summer, which was prolonged into the early autumn. In the Midland counties the range was 69°, from 94° to 25°, and in the south-west of England it was 71°, from 91° to 20°. The autumn rains have varied considerably in different parts of the kingdom; they were in excess of the average over the eastern portion of Great Britain, in the north-west of England, the south of Ireland, and in the English Channel. The least aggregate autumn

rainfall is 6·88 inches, in the Midland counties, which is 0·48 inch below the normal; whilst in the south-east of England the aggregate fall is 10·47 inches, which is 1·08 inches more than the average. The absolutely largest rain measurement is 13·78 inches, in the north of Scotland, which, however, is 1·82 inches less than the normal. The number of rainy days are nowhere very different from the average, the greatest number being fifty-eight days, in the north of Scotland and in the south of Ireland; the least forty-seven days, in the south-east of England. The duration of bright sunshine was in excess of the average over the entire kingdom, except in the English Channel. The greatest duration is 382 hours, in the south-east of England, which is sixty-nine hours more than usual.

MR. M. A. HUNTER, of the electrical engineering department of the Rensselaer Polytechnic, Troy, has succeeded in producing metallic titanium in a state of purity greater than has been hitherto possible. He uses the method of Nilson and Petersson, *i.e.* reduces the tetrachloride of titanium by heating it with metallic sodium in an air-tight steel bomb capable of withstanding an internal pressure of more than 5000 atmospheres. With a charge of 500 grams of the tetrachloride and 245 grams of sodium, after heating the bomb to redness to start the reaction and then allowing it to cool, he obtained 71 grams of molten metal, 31·5 of coarse and 4·5 of fine powder, as against a theoretical yield of 126 grams. Analysis of the product appears to indicate that the molten material is pure titanium. Messrs. Hunter and Jones find that the density of the metal is 4·50, and its specific heat between 0° C. and 100° C. is 0·1462.

VOL. iv. of the Journal of the Municipal School of Technology, Manchester, a record of the investigations carried out by the staff and students, and published in the technical Press or the Proceedings of scientific societies during the year 1910, is not so bulky as its immediate predecessors, although it runs to 250 pages. The papers reprinted are, on the whole, short, and they deal principally with the applications of electricity in engineering or of chemistry in textile processes. Of the longer papers, those of Prof. Schwartz and his staff on the physical and electrical properties of indiarubber and on the field of the polyphase motor may be mentioned. In an important paper by Prof. Haldane Gee and Mr. Harrison, reprinted from the Transactions of the Faraday Society, the authors bring forward weighty experimental evidence in favour of the electrical theory of dyeing. According to this theory, a basic dye is positively, and an acid dye negatively, charged, and the processes through which the fabric passes before it is brought into the dye are such as to charge it negatively or positively respectively, so that there may be electrical attraction between dye and fabric. The number of "laws of dyeing" which the electrical theory places on a firm scientific basis is remarkable.

AMONG primary plant materials, the pentosans, so widely diffused, form a class of substances the origin and function of which are still uncertain in spite of numerous researches which have been made to throw light on these problems. An interesting contribution to the question is found in a paper by Ciro Ravenna in the *Gazzetta Chimica Italiana* (vol. xli., p. 115). It is shown as the result of a large number of experiments, in which the pentosans were estimated in the very young, primary leaves of the beech and of *Vicia faba minor*, at dawn and sunset, that no marked variation in their amount can be traced during the period of chlorophyllian activity; but at night considerable but irregular variations occur, generally in the direction of increase, but sometimes in that of decrease. Wh[...] however, the stalk of the growing leaf is immersed in [...] nutritive solution containing 2 per cent. of dextrose, a[...] the plant allowed to continue its growth for several da[...] exposed to sunlight in an atmosphere free from carb[...] dioxide, the proportion of pentosans is very largely [...]creased, being often nearly doubled. A similar, but not [...] well marked, result was obtained in experiments in wh[...] the plant continued its growth in the nutritive solution [...] darkness, but in an atmosphere containing the ordina[...] proportion of carbon dioxide. It is contended that [...] pentosans are elaborated, not from the complex p[...] saccharides, such as starch and cellulose, by down-gr[...] changes, as is generally supposed, but that they are form[...] direct from the simple carbohydrates. It is also sho[...] that when the chlorophyllian activity is inhibited, [...] pentosans diminish in relative amount, so that it w[...] appear that, in addition to their other functions, they [...] capable also of acting as reserve material for the plant.

A PROPOSAL for the reform of income tax and est[...] duty is put forward by Mr. Douglas White in T[...] *Economic Journal*, xxi. 83. According to the auth[...] proposed system, the rate per pound at which an inc[...] would be taxed would be proportional to the logarithm [...] the income, so that as incomes increased in geometric pr[...]gression the rate of the tax would increase in arithmet[...] progression. If, as Mr. White proposes, this system w[...] carried out rigorously with the use of logarithm tables, [...] would certainly, as alleged, remove the discontinuities [...] the present system, where what a man pays is regula[...] largely by whether his income falls on a lucky num[...] such as 499*l.*, or an unlucky one such as 501*l.* In practi[...] it would be sure to be simplified by retaining these d[...]continuities, for which a much simpler, obvious rem[...] is possible.

A PAPER on the design of tall chimneys was read [...] Mr. Henry Adams before the Society of Engineers [...] December 4. Tall chimneys ought to be designed up[...] scientific principles so that there is an absolute guaran[...] for their stability. The object of Mr. Adams's paper w[...] to elucidate these principles and apply them to practi[...] There are several rules for determining the height of [...] tall chimney; in some towns 45 feet may be sufficient, b[...] in others 90 feet is the minimum allowed. The height m[...] be determined from the amount of coal burnt, or from [...] length of boiler and flues. Four different rules were gi[...] for the sectional area, depending upon the amount of [...] burnt per hour, the fire-grate area, the horse-power of [...] engine, or a combination of these with the height of [...] chimney. The shape may be square, octagonal, or circu[...] the effective wind pressure varying in each case. T[...] author's formula for wind pressure takes account of h[...] and width, increasing with the distance from the gr[...] and increasing also with reduced width. Eight authori[...] were quoted for the coefficient of pressure for a circ[...] shaft varying from 0·5 to 0·7854. The thickness of [...] brickwork varies 4½ inches every 20 feet in height, [...] the top length will be from one to one and a half bri[...] thick, according to the height and diameter. The over-width at base must be at least one-tenth, and if circular [...] least one-twelfth, of the total height. After the sectio[...] drawn out to suit the conditions, the stability should [...] calculated at each set-off. The principles of stability m[...] be illustrated by considering a solid square brick pier.

MR. LIVINGSTONE SULMAN, president of the Institut[...] of Mining and Metallurgy, delivered an address at t[...] annual prize distribution of the Sir John Cass Techni[...]

Institute on November 29. In the course of his address Mr. Sulman pointed out that the dominant thought which impressed one to-day was the many-sidedness, the increasing scope, and the intense vigour which now marks metallurgical progress. The interaction of associated sciences is now beginning to play its part in the development of metallurgical industries. Certain of the factors of so-called molecular energy find expression in some of the newer processes and phenomena of metallurgy, as shown in the methods adopted to the harnessing of molecular attractions which reside upon the surfaces of solids, to the purposes of ore concentration. These methods, which have, for example, completely changed the economic outlook of the great Broken Hill deposits of silver-lead-zinc ores, are there used to separate the blends constituent in saleable form from the "tailings" left behind after the bulk of the lead and silver have been recovered. But they are applicable, in general, to all sulphide ores, as well as to finely divided metals and non-metals, such as gold, graphite, carbon, diamond, sulphur, and so on; and they are frequently spoken of as "oil processes," from the fact that in several of them oil is used in larger or smaller quantities, usually in smaller. In such processes there are no chemical reactions to speak of; physical forces of previously unsuspected range and power, so far as commercial applications are concerned, have been induced to do the work more easily and much more economically, the force mainly concerned being what is called "surface energy." Equally new, and probably of great importance to the metallurgist of the future, are the developments in colloidal chemistry. The plasticity of clays and "ultra-sliminess" of "slimes" are due to this class of bodies, in which inorganic materials ape the reactions of organic; a clay colloid may almost be said to masquerade as a fatty acid. Mr. Sulman also referred to the extended application of improved magnetic and electrostatic methods for the separation of dry ores, and to catalytic processes of metallurgical importance.

A SELECTED "List of Educational Books for Schools, Colleges, and Self-tuition," issued by Messrs. W. and G. Foyle, 135 Charing Cross Road, London, W.C., has reached us. Nearly all the books included in the catalogue can be supplied secondhand at half the published prices; and Messrs. Foyle will send any book in stock on approval.

MESSRS. WILLIAM WESLEY AND SON, 28 Essex Street, London, W.C., have sent us a copy of the latest issue of their "Natural History and Scientific Book Circular." It contains a catalogue of 356 selected books on natural history, with coloured illustrations, followed by a list of works published by, or on sale with, Messrs. Wesley and Son, who are, it may be added, agents for the Smithsonian Institution and the U.S. Government departments.

MESSRS. J. WHELDON AND CO. (38 Great Queen Street, Kingsway, W.C.) have just issued a supplement to their scientific and geological catalogues. The supplement comprises recent purchases in astronomy, chemistry, geology, palæontology, mineralogy, mining, &c., and includes a small collection of works on applied chemistry, metallurgy, and other subjects.

Erratum.—We are asked to state that in the abstract of Mr. Hutchinson's paper read before the Mineralogical Society (p. 165) the temperature at which gypsum becomes optically uniaxial should be 95° C., not 25° C. The incorrect value was given in the typewritten report received by us, and the error was not corrected in the proof submitted and returned to the printers.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET, 1911*h*.—A telegram from Kiel announces the discovery of a new comet by M. Schaumasse, at Nice, on November 30. Its position at 17h. 15·9m. (Nice M.T.) was

R.A. = 13h. 12·2m., dec. = 5° 51′ N.,

and its daily motion was found to be +3m. 32s. in R.A. and −13′ in declination; the magnitude is 12·0.

A second telegram gives an observation by Dr. Abetti at Arcetri on December 2, the position at 17h. 26·9m. (Arcetri M.T.) being

R.A. = 13h. 19m. 17·6s., dec. = 5° 24′ 29″ N.

The comet is thus seen to be moving in a south-east direction through Virgo.

BORRELLY'S COMET, 1911*e*.—Borelly's comet, rediscovered by Mr. Knox Shaw on September 19, is approaching both the sun and the earth. As the perihelion passage will take place on December 18, when the comet is nearly in opposition with the sun, and as the comet is moving northwards rapidly, it may become visible with opera-glasses during the latter part of December and in January, 1912 (*L'Astronomie*, November).

THE PRODUCTION OF STAR STREAMS.—A paper by Prof. Benjamin Boss, in No. 629 of *The Astronomical Journal*, discusses, in relation to a star stream he has found among seventy-one large proper-motion stars given in the Preliminary General Catalogue, the somewhat startling suggestion that community of direction and velocity in such streams may be caused by the initiation and maintenance of their motions in an electromagnetic field of universal extent.

The directions and proper motions of eleven of these large proper-motion stars, together with their radial velocities and parallaxes where available, agree so well as to preclude the idea of chance occurrence, and some physical explanation is sought.

Assuming that the stars form from nebulæ, the motion of the latter might explain the phenomena; but the extended nebulæ do not exhibit such *motus peculiaris*, and Prof. Boss seeks the common cause elsewhere.

The suggestion is that the nebulæ are the seat of tremendous ionisation forces producing segregation, and electromagnetic polarities in the segregated masses. In the course of time a relatively strongly polarised mass becomes expelled from the matrix and commences a stellar existence. Initially the directions would be haphazard, but the action of the supposed universally existent electromagnetic field would be to swing the polarised masses into paths along the approximately parallel lines of force. Assuming the B-type stars to be the newest, Prof. Boss finds support in the fact that such stars display random motions, while those in his group of large proper-motion stars, exhibiting community of direction, are of the types F, G, and K. Further, the action of a constant acceleration such as is suggested would tend to level up the differences found in the initial velocities, thus producing the community of velocity observed.

DOUBLE-STAR MEASURES.—In No. 4534 of the *Astronomische Nachrichten* Prof. Burnham publishes a long list of recent measures of double stars related largely to the proper motion of stellar systems contained in his General Catalogue. The measures were made with the 40-inch refractor at the Yerkes Observatory, and follow on Prof. Burnham's similar publications in the same journal.

In No. 4537 Herr J. Voûte publishes a second list of double-star measures, which will later be published *in extenso* in the Annals of Leyden Observatory.

RADIAL VELOCITY OF α CYGNI.—Some time ago we directed attention to a result obtained by Prof. Belopolsky and Mr. Neuimin in which they found what appeared to be a real difference between the radial velocity of α Cygni as determined from the metallic lines and that determined from the hydrogen and helium lines. At the suggestion of Prof. Frost, Mr. O. J. Lee has examined some measures of the spectrum made by him in 1910, and he fails to find any confirmation of the Pulkowa results. He suggests that the discrepancy found by Neuimin and Belopolsky

may be due to slight differences of complexity in the hydrogen-line images (*Astrophysical Journal*, vol. xxxiv., No. 4).

THE SPECTRUM OF THE OUTER PLANETS.—In No. 4537 of the *Astronomische Nachrichten* Dr. Otto Büry publishes a note in which he shows that the well-known characteristic absorption-band spectrum of the outer planets can be fairly well matched by combining Chappuis's and Schöne's ozone spectra with the spectrum of the higher oxides of nitrogen obtained by Chappuis. As shown on the plate accompanying the paper, the chief bands in Vogel's spectrum of Uranus, for example, are fairly well represented in the ozone and peroxide spectra; such differences as exist might perhaps become explained if the terrestrial spectra were experimented with more exhaustively under different temperatures and pressures; for Chappuis has shown that the ozone spectrum is sensitive to such changes.

SUN-SPOTS AND CLIMATE.—Considering the climate of Berlin as depicted in the temperature records from 1756 to 1907, and the precipitation records from 1848 to 1907, Herr Otto Meissner finds a possible connection between these climatic features and the periodicity of sun-spots. In a table which he gives in No. 4533 of the *Astronomische Nachrichten* he arranges the years of the eleven-year period from 1 to 11, and opposite each gives the departures of the year's temperature and rainfall from the means. This indicates that the sun-spot maximum years are cold and wet, while the minimum years accord fairly well with the mean. A further investigation considering pressure is to be undertaken.

PROPOSED MEMORIAL TO PROF. P. G. TAIT.

ON Thursday last, November 30, a representative meeting of former students and friends of the late Prof. Tait was held at Edinburgh University, to consider the question of extending the memorials to him. His former colleague, Principal Sir William Turner, K.C.B., presided. About 150 apologies for absence were intimated, amongst these being expressions of approval and support from the Rt. Hon. A. J. Balfour, M.P., the Chancellor of the University; the Right Hon. Lord Aberconway; Sir Archibald Geikie, K.C.B., President of the Royal Society; Sir John Murray, K.C.B., and the Right Hon. Lord Haldane of Cloan, P.C. Lord Haldane wrote:—"I cannot be with you on the 30th, but I wish to say that I am very glad indeed that you are taking the step of raising a memorial fund in connection with Prof. Tait. The publication of his Life affords a suitable occasion for doing this. I shall be glad to be a contributor, for I feel that a record should be preserved of the regard in which his old students and the nation generally held this remarkable man. We have too few figures of the stature of Tait to let them pass away without endeavouring to keep a permanent memorial of their greatness."

As it is now almost a decade since Prof. Tait's death, his successor in the natural philosophy chair (Prof. J. G. MacGregor) made the following statement:—In explanation of the present state of this movement, it may be pointed out that Prof. Tait's main work can be divided into three portions: (1) his educational work, (2) his own experimental researches, and (3) his work in mathematical physics. An appropriate memorial might be raised in connection with any one or more of these. When he entered upon the work of the natural philosophy chair he was deeply impressed by the soundness of Prof. Tait's educational policy, and by the difficulties in the way of applying and extending it; and he suggested as a fitting memorial a fund which would make it possible to carry it out. Without the aid of any appeal, this suggestion led to the receipt of subscriptions to the amount of about 1500*l*. But before action could be taken, it was found that the University itself was organising, and could not defer, a general extension scheme. It was the unanimous opinion of those who had charge of this scheme that it would be unwise to carry on two competing movements at the same time; and the Tait memorial was for this reason made a department of the general extension scheme.

As such it could not be brought to the attention of old students and associates generally, but only to a comparatively small number of them. Nevertheless, additional subscriptions were made to the original fund to the extent of about 500*l*., and a special fund, yielding about 200*l*. per annum, was provided by Sir John Jackson, to be called Professor Tait's Memorial Fund, and to be used, under the direction of trustees, for research on the lines of Prof. Tait's experimental work.

There are thus memorial funds connected with two of the chief departments of Prof. Tait's activity, but none connected with the third.

The best form for a memorial connected with the professor's work in mathematical physics would obviously be a Tait chair in that subject; and Tait himself advocated the establishment of such a chair. In 1872 he wrote in an article in *Macmillan's Magazine*:—"Would it were not absolutely hoping against hope to proceed as follows. In the Scottish universities, let there be in each a professor of experimental physics and a professor of applied mathematics, in place of the present solitary professor of the enormous subject of natural philosophy."

Many old students have intimated that they would like to have the opportunity of contributing to a memorial. He was satisfied that a very large proportion of them would be found to share this feeling.

It will thus be seen that, as a Tait memorial has been founded, the question before this meeting is, shall we take for ourselves, and arrange to give to the whole body of the professor's students and associates and admirers, the opportunity of contributing towards the memorial, and, by enlarging the original fund, or founding a Tait chair, or in any other way that may be determined, making the memorial more worthy even than it now is of the man whose great work, personal and scientific, it is intended to commemorate?

On the motion of Mr. B. Hall Blyth, seconded by Sir G. M. Paul, a resolution agreeing to the proposal was carried.

A general and an executive committee were then appointed. Information will be willingly furnished by Prof. J. G. MacGregor, Edinburgh.

BIRD-NOTES.

IN the October number of *British Birds* another straggler is added to the British list—this time in the shape of the slender-billed curlew (*Numenius tenuirostris*), a small flock of which was observed towards the end of September, 1910, on Romney Marsh, Kent. Of these, an immature pair were shot on September 21, while an adult male was killed two days later. Two of them were examined in the flesh by Mr. M. J. Nicoll. Although stragglers have occurred in Heligoland, Holland, Belgium, northern France, and Germany, the slender-billed curlew is a native of the Mediterranean countries, whence it travels to Siberia to breed. Approximating in size to the whimbrel, the species is distinguished by its short and slender beak and the pear-shaped dark markings on the flanks. The colouring of the crown is unlike that of the whimbrel, showing black and buff streaks like those of the curlew.

In the same issue Dr. E. Hartert points out that English green woodpeckers differ from the central European representative of the species (*Picus viridis pinetorum*) by the still shorter and more slender beak, and on this character proposes that it should be recognised as a separate race (*P. v. pluvius*). Scandinavia, Russia, and eastern Prussia are the home of the typical race; the Italian form, on account of the beak being slenderer than in English birds, is named *P. v. fronus*, and the Spanish *P. v. sharpei* has long been recognised as distinct.

Most ornithologists, when pointing out the features in the plumage by which young partridges may be distinguished from old ones, content themselves with the statement that the tip of the first flight-feather of the wing is pointed in the former, but rounded in birds which have undergone their second autumnal moult. Dr. Louis Bureau, director of the Nantes Museum, in an article (in French) published in the October *Zoologist*, goes, however, much further than this. After stating that there are ten primary wing-quills, he observes that the tenth of the first plumage is the first to fall, this taking place about the end of the first month; when the replacing quill (second plumage) has attained a

length of about 15 mm.—which it does in three days—the ninth quill of the first plumage is moulted and replaced in a similar manner. After this the eighth, seventh, sixth, fifth, fourth, and third quills are successively shed and replaced, but at regularly increasing intervals, the rate of the development of their successors during twenty-four hours decreasing in the same order. The second and first quills are not shed at all during the first moult, but persist until the completion of the second moult, in September or October of the following year. This renders it possible to determine during a period of fifteen or sixteen months whether a partridge is young or old, the tip of the first quill being pointed up to that age and rounded subsequently. After this period age-determination by the plumage is impossible. The author adds that, by following the formula given above, the exact age of young partridges is determinable during the time that quill-moulting is in progress, although it has to be borne in mind that there may be a small "personal equation," some individuals moulting slightly in advance of, and others behind, their fellows.

In this connection it may be noted that *Country Life* of October 21 contains an article by the present writer on the breeding-ages of birds, in which attention is directed to the imperfect state of our knowledge on this subject.

The results of an expedition to the pheasant-countries of Asia are recorded by Mr. C. W. Beebe in the July issue (recently to hand) of the New York Zoological Society's Bulletin. It is stated that "this expedition, organised for the purpose of gathering original data for the preparation of a monograph of the pheasants, jungle-fowl, and peafowl, and made possible by the generous gift of Colonel A. R. Kuser, has been completed. The most sanguine expectations were exceeded in the amount of territory covered and the results attained. Voluminous notes have been taken, reinforced by a great number of photographs (some of which are reproduced in the article) and sketches, concerning the habits and ecology of the pheasants found in the countries visited, much of the material being new to science. Although the collecting of living birds was a secondary object of the expedition, several large shipments were sent back." In the same number it is stated that a female passenger-pigeon now in the Cincinnati Zoological Gardens is believed to be the last living representative of that once abundant species.

The need of a longer close season for the Australian stubble-quail (*Coturnix pectoralis*) is strongly urged by Mr. G. A. Keartland in the September number of *The Victorian Naturalist*. For a short time the close season was from August 1 to December 20; it was extended at different times to February 1, March 1, and April 1; but this year it has been put back to February 14, which the author urges is much too early, as many of the broods are then "cheapers." R. L.

THE SEVENTEEN-YEAR CICADA.

THE Cicadidæ are an interesting group of insects, which chiefly inhabit warm countries. They are represented in England by a small species (*Cicadetta montana*) which is almost confined to the New Forest, where it is scarce and local. In classical times they were known under the name of Tettix, and the loud stridulation of the males attracted much attention. As in England, so in the eastern United States, there is only one species which is common and well known, *Tibicina septendecim*, the peculiarity of which is that its life-cycle occupies seventeen years in the northern, and thirteen in the southern, States, and only at these intervals are they specially abundant. In America they are often improperly called locusts, and are reckoned among destructive insects, for the larva feeds on the roots of trees; and it is ranked among injurious insects.

The eggs are laid on the twigs of trees, and when the larvæ are hatched they drop to the ground and gather in clusters on the roots, from which they suck the sap. The pupa-state lasts only a few days, and when ready to emerge they form galleries, through which they ascend to the surface of the ground, and emerge, leaving their cast skins behind them. The perfect insect is easily recognisable, having a short, broad black body rather pointed at the hinder extremity, and four long and moderately broad wings with conspicuous reddish nervures, the fore wings being considerably larger and more pointed than the hind wings.

The Times of November 3 directs attention to the emergence of numbers of these insects during the last summer from the soil in the Bronx Zoological Park in New York; but when the writer adds, somewhat inconsequentially, "It is probable that the species is approaching extinction in view of modern conditions of cultivation, and the extension of building areas," we imagine that the contingency can hardly be so near as he supposes, although the complete extermination of once common insects in consequence of the changed conditions to which he refers is no uncommon occurrence. W. F. K.

SCIENTIFIC PROGRESS AND PROSPECTS.[1]

ALL advance in the relations between man and nature whereby man gains to any greater extent the mastery may be described as scientific progress; and in this connection we must recognise that many things which we now look upon, and have for ages regarded as entirely commonplace, were, at the time of their inception, really very remarkable indeed. Take, for instance, the application to human needs of fire. Animals, even of the highest types, make no use of it. There must have been a period when man also did not understand its properties, and, like the animals from which he has sprung, was afraid of it and left it severely alone. A time must next have come, and with that time the valorous man who first had the temerity to experiment with this very powerful and destructive agent.

Think of this prehistoric investigator into the means and effects of combustion in that far distant age; consider his inferior mental equipment; imagine his savage surroundings; take into account, also, his lack of any but the most primitive appliances. Must we not laud his enterprise and admire his courage? Must we not also acknowledge the enormous advantages his investigations have gained for all his posterity? The warming of their bodies and the cooking of both animal and vegetable nutriment would, no doubt, be the first uses to which our remote ancestors would apply the new agent; but soon would follow the firing of pottery, up to that date merely sun-baked, then the reduction and smelting of metals, and finally the whole galaxy of the arts. What is scientific progress if this is not? And yet it leaves off where what we usually mean by science begins, namely, about the Græco-Roman period. Look out, however, into London to-day, and recognise how little of all we see around us could have ever existed but for those early high-temperature experiments made so many thousands of years ago. Without them, could human beings even live in this northern climate?

Here may I point out that, curiously enough, it is only when we go back to the earliest evidences of primitive human life upon this planet that we take the true philosophical course of naming the periods we are dealing with after the main material advances in scientific progress made during those periods by the human race. We talk of the Stone age, of the Bronze age, or the Iron age, to denote those vast expanses of time during which the primitive inventor was discovering the means of applying new materials to what was then the great necessity of mankind, namely, weapons for the chase, for self-protection, and for war upon his enemies.

Later in history we find that this really philosophical method is abandoned. As we come to know more as regards the position, supremacy, and conditions of particular races, and still further when we become better acquainted with the deeds and achievements of particular individuals, we find that historians have a tendency to overlook the enormous influence of the results obtained by scientific investigators and discoverers, and to make it appear as though the current of events were really governed by those who, from accident of birth, official position, political influence, or martial achievements, have made for themselves reputations as leaders of men.

To see that this view is wrong we have only to survey the past. Can it for an instant be doubted that the labours of the unknown prehistoric individual to whom I have just

[1] From the presidential address delivered to the Röntgen Society on November 7 by Mr. A. A. Campbell Swinton.

alluded, who first discovered the properties of fire, or of those who originated the smelting of metals, who launched their frail, and at that time novel, coracles upon the ocean, and first applied wheels to the primitive cart, are more living factors to-day than the valour of all the warriors, the wisdom of all the statesmen, or the wiles of all the politicians that the world has seen? It is a truism, indeed, that the world knows little of its greatest men.

Can it be questioned that the discoveries of Archimedes and his disciples have more effect to-day than the battles of Alexander or of Hannibal? Or, if we turn to modern times, can it be gainsaid that Watt and Stephenson, Davy and Faraday, have done more to change both the course of history and the material conditions of life than did Napoleon or Wellington, Walpole or Pitt?

The fact is, as I once remember hearing lamented by no less a statesman than the late Lord Salisbury, that while the work of the politician, the statesman, the soldier, or the leader of men, however great and however fortunate, is of necessity but transitory, what is accomplished by one man being undone by another—the work of the scientific discoverer and inventor is everlasting. However insignificant this work may apparently be, provided it is new it adds something more to that great store of human knowledge and experience which is slowly accumulating, and enables man more and more to triumph over nature. Moreover, results that appear of but slender importance at the time of their discovery often turn out in the end to be of the greatest moment.

For the undue amount of influence on the progress of the world that is attributed to leaders of men, in comparison with that exerted by investigators of nature, historians are no doubt to blame. In stating this, however, one must in justice remember that, after all, most histories are written to sell, or, if not that, to bring fame to their authors. Further, we must allow that the story of scientific investigation is frequently not very interesting, at any rate to the general public, who may justly find such a story dull as compared with accounts of the stirring episodes that occur in the Senate or the feuds that are settled on the battlefield. Thus the tale of, say, Marlborough's campaigns makes probably more picturesque reading, and is more likely to interest the average student, than would be a history of the patient scientific work that led up, about the same period, to the enunciation, say, of Boyle's law of the expansion of gases. We can admit this, though there can be no doubt that the permanent influence of Boyle's discovery on the history of the world has been in the past, and will continue to be in still greater ratio in the future, incomparably greater than was that of all the battles of the day, inasmuch as Boyle's law was an important link in the chain of discoveries that led up to the steam engine and modern industrial development; while to-day the effects of the wars of the seventeenth century have, for all practical purposes, passed away.

The fact is that there is a glamour attached to the position of those who are supposed to direct the history of nations that prevents the real directing forces from being seen in their true proportions. The great statesment, the great generals, leaders of mankind in general, are, after all, nothing much more than glorified policemen, whose utility to the world is only occasioned by the imperfections of human nature. As organisers they are no doubt useful, but they generally benefit particular nations at the expense of others; and, as a rule, they leave little behind them that will stand the test of centuries.

Another product of human endeavour which also seems to have an undue amount of importance attached to it in regard to its influence on human progress is literature, which I am here considering apart entirely from its æsthetic claims upon us as a means of relaxation. That literature has a directive influence, and that a powerful one, no one can deny; but I fancy that all scientific men will agree that it is not to be compared with that exercised by material discoveries and inventions. In saying this, I know that it is the fashion to ascribe the beginning of all modern science to what is contained in the "Novum Organum"; but I rather fancy that if we could truly estimate the influence on the world's history of the two men, we should find that Roger Bacon, the inventor of gunpowder, would come before the better known Francis Bacon, who, some centuries later, wrote his great work on the new learning. Indeed, probably the chief merit of the "Novum Organum" was that it assisted a return to experimental methods as opposed to what had become the benumbing system of Aristotle, who, by the way, is interesting to this society for the reason that he was the author of the immortal, if not very illuminating, phrase that "nature abhors a vacuum." Anyway, since the earliest times there has never been a better organised and more successful mutual admiration society than that formed by the writers of the world, who have always been chiefly concerned to discuss one another and one another's scripts. This, and the fact that the written word endures, has given to the wielders of the pen a prominence in history to which they are scarcely entitled by their influence on progress.

At the present time, when it is the fashion to ascribe the production of all wealth to the manual labourer and all progress to the politician, it is more than ever necessary that correct views should be insisted on. Let us, therefore, emphasise the fact that from the beginning of the world all advance has been due, not to the many, but to a few exceptional individuals; and had it not been for the genius of these we should still be naked savages, not even painted with the proverbial woad.

As an instance, take the electric telegraph, which has had more effect on civilisation than almost anything else during the past century, and gives employment to thousands. The names of those to whom it is due, beginning with Franklin, Volta, and Galvani, going on with Morse and Cook, and ending with, say, Wheatstone and Kelvin, can literally be counted upon one's fingers. Nor is it very different with the steam engine or with the railway itself, which, to read some of the newspapers of to-day, one would almost think had been invented by the rank and file of the railway workers.

Most really scientific workers feel that knowledge for knowledge's sake is a sufficiently worthy object for pursuit, and are content with the extension of knowledge and the satisfaction that it brings without immediately desiring precise information as to the practical results that are likely to follow from any particular line of investigation. It is well that this is so, as otherwise many of the lines of scientific research that have been most fruitful in bringing lasting benefits to mankind would never have been begun or followed up.

As an instance of this, could there be a better example than the history of that most remarkable and important discovery in physics which was the primary cause of the foundation of this society?

Consider for a moment the position of affairs many years ago, when Sir William Crookes first commenced his laborious experiments on the electric discharge through rarefied gases. Could anything be imagined of more purely academic interest, and, at the time, seemingly less likely to lead to results of a practical nature? The small scale, the extreme delicacy of the apparatus, the uncertainty of the results, the minuteness of the forces involved, all tended to give to the investigations an air so entirely aloof from the practical concerns of everyday life that one can scarcely wonder that for years it was only a few of the very foremost scientific intellects who had sufficient insight to take much interest in the matter.

Yet we all know how things have turned out; how, as a direct result from these very recondite investigations, we have had the discovery of the Röntgen rays, with their practical applications to the investigation of the human frame, to the relief of suffering, and to the cure of disease; and also, as another result, perhaps the most momentous and far-reaching upheaval in scientific thought on the constitution of matter and the nature of electricity that has taken place for centuries, heralding the birth of a new idea, that of radio-activity, which may in future be destined to prove the salvation of the whole human race from annihilation. Here, of course, I refer to the vast and previously unsuspected source of energy that modern investigations have shown to lie hidden away in the atoms of matter, a store which is revealed by the energy given out by radium and other radio-active substances, and one which we may hope to see made available for human use in centuries to come, when others, such as those contained

n the coal and oil of the earth, at present being exploited, re exhausted.

So far as I am aware, the results of modern discovery ave had no effect in weakening our belief in the truth of he great principle of the conservation of energy as defined n what is commonly called the first law of thermodynamics, which law is really a statement that the sum f energy in the universe, just as the amount of matter, s a constant, and cannot be either increased or diminished y any means whatever.

When, however, we come to the so-called second law, which, as stated by Clausius, is that it is impossible for a elf-acting machine, unaided by external agency, to convey eat from one body to another at a higher temperature, r, as given by Lord Kelvin in a somewhat different form, hat it is impossible by means of inanimate material gency to derive mechanical effect from any portion of natter by cooling it below the temperature of the coldest f the surrounding objects, we find that even the authors f these statements are prepared to admit that this second aw stands on a totally different basis from the first law, nd, as declared by Maxwell, can only be said to be tatistically correct, or correct only when we are dealing vith masses of matter and not with individual molecules.

Indeed, it was in this connection that Maxwell propounded his celebrated proposition, in which he supposes hat a demon who could see individual molecules, and was ossessed of superhuman dexterity, could open and close n aperture in a partition dividing a vessel into two eparate portions, A and B, so as to allow only the swifter nolecules to pass from A to B, and only the slower ones rom B to A, in which case, without the expenditure of vork, the temperature of B would be raised and that of A lowered, in contradiction to this second law.

It will further be observed that in the definitions quoted bove Clausius is careful to qualify his statement by words o the effect that there must be no external aid, while ord Kelvin is even still more specific, and expressly limits he whole law to things inanimate.

Now lately, in London, we have had—I suppose s the result of Prof. Bergson's remarkable writings—one f the usual periodic outbreaks of more or less metaphysical discussion, and, incidentally, there has been raised uite seriously the question as to whether living organisms re subject to these laws of thermodynamics or not.

So far as the first law is concerned, there seems to be omplete agreement that there can be no question of any ut an affirmative reply, as we can scarcely suppose living hings to be capable of creating energy any more than of reating matter.

But when we come to the second law there are apparntly those who hold that it is different—who, in fact, elieve that there is good reason for doubting whether this econd law, which prevents us by the use of any mere nachine from getting mechanical effect from the general tock of heat, applies to living organisms at all. Indeed, n the contrary, it is contended that it is probable that, n the case of certain animate bodies, this is actually being ccomplished all the time; in other words, that there exist ving things which in some fashion or other do very much hat was the business of Maxwell's demons to do, and in his manner extract the energy that they require from the eneral stock. Here, obviously, is a most important natter for investigation, and one, having regard to its ombined physiological and physical aspects, peculiarly dapted to be tackled by the members of the Röntgen ociety, that is to say, if those who put it forward can nake out a sufficient case to make actual experiment orth while.

The interest of the question will be especially apparent o anyone who has seen the so-called Brownian movements hich can be perceived by ultramicroscopic methods in nely divided solid matter, such as particles of colloidal old suspended in a liquid or of tobacco smoke in a gas. hese movements are now believed to be due to the actual ostling of the minute particles by the moving molecules hemselves, and give the most wonderful notion of the easeless state of agitation that exists among the molecules f all substances at any temperature above that of the ltimate zero, and the vast amount of energy that is stored n these perpetual movements.

Indeed, so remarkable do the Brownian movements appear that their original discoverer, who detected them in finely divided vegetable matter, came to the conclusion that the particles were alive.

To return to the main question, however, without presuming to pronounce any opinion one way or another on the very startling idea that living matter is not always subject to the second law of thermodynamics, but finds means, in some cases at all events, to evade its provision, I desire to direct attention to the stupendous consequences that would follow could such a view be established. Here, at last, we should have the equivalent of the perpetually burning lamp of the story books, which consumed no oil; the perpetual fire of the burning bush, which required no fuel. We should have immediately to hand the means of producing the perpetual motion dreamed of by mediæval philosophers. We should only have to cultivate the right kind of organisms in sufficient masses, and they would do all this for us. Moreover, there would be nothing lost; the heat that was thus accumulated locally for our needs would dissipate itself again into the common store, as would also the mechanical effects after they had done their work. The unordered molecular motions of which the Brownian movements give us an indication—motions which constitute heat—would merely be directed for a time in the particular manner needful to give us the power that we require. Life would be the directing force; but it would be a directing force only, and would do no work.

It is a fascinating prospect, giving us a glimpse of what some may perhaps think is destined to take the place of fuel a few hundred years hence, when the latter is all exhausted and before means have been found to unlock the still greater stores of atomic energy that have already been alluded to. To those, however, who have been brought up to rely on the orthodox doctrines of thermodynamics, it seems not only very revolutionary, but also very heterodox from a physical point of view. Personally, as one totally ignorant of biology, I am only here concerned to point out the inevitable consequence of admitting that living matter is not subject to the second thermodynamic law, a proposition which I venture to believe has never before now been put forward seriously in any responsible quarters.

Among the many scientific problems that await solution, problems which, if satisfactorily solved, would have an enormous effect on the habits of mankind, is that of distant electric vision, or the power to see objects a great way off by electrical means; in other words, to do for the sense of sight what the telephone has done for the sense of hearing. Indeed, if this extension of our sense of vision was obtained, we could well afford to dispense with any extension of our other senses, namely, those of taste, smell, and touch, the senses of sight and of hearing being, for all ordinary purposes, much more important to us than are the others.

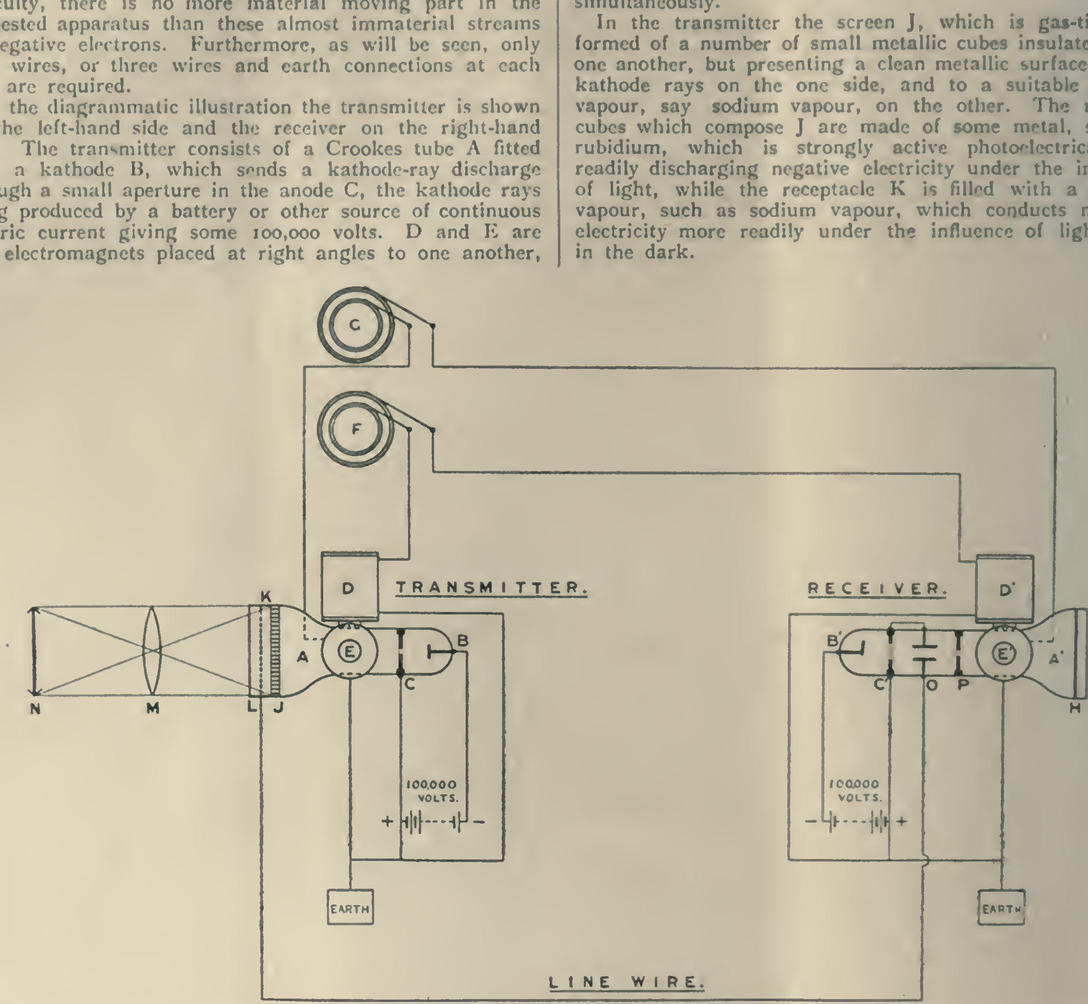
So long ago as the year 1908, in connection with a paper published in NATURE by the late Mr. Shelford Bidwell, I wrote a letter in that journal suggesting that the difficulty of obtaining the necessary enormous numbers of synchronised operations per second could possibly be solved by the employment of two beams of kathode rays, one at the transmitting and one at the receiving station, sychronously deflected by the varying fields of two electromagnets placed at right angles to one another and energised by two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams would be caused to sweep synchronously over the whole of the required surfaces within the one-tenth of a second necessary to take advantage of visual persistence; and that, so far as the receiving apparatus was concerned, the moving kathode beam would only have to be arranged to impinge on a sufficiently sensitive fluorescent screen, and, given suitable variations in its intensity, to obtain the desired result. As, since that date, I have several times been asked to explain more in detail this idea, I now propose to do so, though it must be distinctly understood that my plan is an idea only, and that the apparatus has never been constructed. Furthermore, I would explain that I do not for a moment suppose it could be got to work without a great deal of experiment, and probably much modification. It is, indeed, only an effort of my imagination, and can be useful merely as a suggestion of a direction in which

experiment might possibly secure what is wanted. What, however, is claimed is that, so far as I am aware, it is the first suggested solution of the problem of distant electric vision in which the difficulty of securing the required extreme rapidity and accuracy of motion of the parts is got over by employing for these parts things of the extreme tenuity and weightlessness of kathode rays. Indeed, apart from the revolving armatures of the alternators employed for synchronisation, which present no difficulty, there is no more material moving part in the suggested apparatus than these almost immaterial streams of negative electrons. Furthermore, as will be seen, only four wires, or three wires and earth connections at each end, are required.

In the diagrammatic illustration the transmitter is shown on the left-hand side and the receiver on the right-hand side. The transmitter consists of a Crookes tube A fitted with a kathode B, which sends a kathode-ray discharge through a small aperture in the anode C, the kathode rays being produced by a battery or other source of continuous electric current giving some 100,000 volts. D and E are two electromagnets placed at right angles to one another,

Similarly, in the transmitting apparatus, the kath[ode] rays fall on a screen J, the whole surface of which t[hey] search out every tenth of a second under the influence [of] the magnets D and E. Further, it is to be remarked th[at] as the two magnets D and D′ and the two magnets [E] and E′ are energised by the same currents, the movem[ents] of the two beams of kathode rays will be exac[tly] synchronous, and the kathode rays will always fall on the two screens H and J on each corresponding sp[ot] simultaneously.

In the transmitter the screen J, which is gas-tight, [is] formed of a number of small metallic cubes insulated fr[om] one another, but presenting a clean metallic surface to the kathode rays on the one side, and to a suitable gas or vapour, say sodium vapour, on the other. The metal cubes which compose J are made of some metal, such as rubidium, which is strongly active photoelectrically [in] readily discharging negative electricity under the influence of light, while the receptacle K is filled with a gas or vapour, such as sodium vapour, which conducts negative electricity more readily under the influence of light than in the dark.



which, when energised by alternating current, will deflect the kathode rays in a vertical and in a horizontal direction respectively.

The receiving apparatus consists similarly of a Crookes tube A′ fitted with a kathode B′, which, in circumstances to be further described, transmits kathode rays through an aperture in the anode C′. D′ and E′ are two electromagnets placed at right angles, similar to those in the transmitter, the two magnets D and D′, which control the vertical motions of the kathode-ray beam, being energised from the same alternating dynamo F, which has a frequency, say, of ten complete alternations per second; while the other two magnets E and E′, which control the horizontal movements of the kathode-ray beam, are energised by a second alternating dynamo G having a frequency of, say, 1000 complete alternations per second.

In the receiver H is a fluorescent screen, upon which, under conditions to be further described, the kathode rays impinge, and the whole surface of which they search out every tenth of a second under the combined deflecting influence of the two magnets D′ and E′, with the result that under these conditions the screen fluoresces with what appears to the eye as a uniform brilliancy.

Parallel to the screen J is another screen of metalli[c] gauze L, and the image to be transmitted of the object [N] is projected by the lens M through the gauze screen L [on] to the screen J through the vapour contained in K. The gauze screen L of the transmitter is connected throu[gh] the line wire to a metallic plate O in the receiver, p[ast] which the kathode rays have to pass. There is, furth[er,] a diaphragm P fitted with an aperture in such a positi[on] as, having regard to the inclined position of B′, to cut o[ff] the kathode rays coming from the latter and prevent them from reaching the screen H unless they are slightly repell[ed] from the plate O, when they are able to pass through the aperture.

The whole apparatus is designed to function [as] follows:—

Assume a uniform beam of kathode rays to be passi[ng] in the Crookes tubes A and A′, and the magnets D and [E] and D′ and E′ to be energised with alternating current, a[s] mentioned. Assume, further, that the image that is desire[d] to be transmitted is strongly projected through the lens [M] through the gauze screen L on to the screen J. Then, a[s] the kathode rays in A oscillate and search out the surfac[e] of J, they will impart a negative charge in turn to all th[e]

metallic cubes of which J is composed. In the case of cubes on which no light is projected, nothing further will happen, the charge dissipating itself in the tube; but in the case of such of those cubes as are brightly illuminated by the projected image, the negative charge imparted to them by the kathode rays will pass away through the ionised gas along the line of the illuminating beam of light until it reaches the screen L, whence the charge will travel by means of the line wire to the plate O of the receiver. This plate will thereby be charged; will slightly repel the kathode rays in the receiver; will enable these rays to pass through the diaphragm P, and, impinging on the fluorescent screen H, will make a spot of light. This will occur in the case of each metallic cube of the screen J, which is illuminated, while each bright spot on the screen H will have relatively exactly the same position as that of the illuminated cube of J. Consequently, as the kathode-ray beam in the transmitter passes over in turn each of the metallic cubes of the screen J, it will indicate by a corresponding bright spot on H whether the cube in J is or is not illuminated, with the result that H, within one-tenth of a second, will be covered with a number of luminous spots exactly corresponding to the luminous image thrown on J by the lens M, to the extent that this image can be reconstructed in a mosaic fashion. By making the beams of kathode rays very thin, by employing a very large number of very small metallic cubes in the screen J, and by employing a very high rate of alternation in the dynamo G, it is obvious that the luminous spots on H by which the image is constituted can be made very small and numerous, with the result that the more these conditions are observed the more distinct and accurate will be the received image.

Furthermore, it is obvious that, by employing for the fluorescent material on the screen H something that has some degree of persistency in its fluorescence, it will be possible to reduce the rate at which the synchronised motions and impulses need take place, though this will only be attained at the expense of being able to follow rapid movements in the image that is being transmitted.

It is further to be noted that as each of the metallic cubes in the screen J acts as an independent photoelectric cell, and is only called upon to act once in a tenth of a second, the arrangement has obvious advantages over other arrangements that have been suggested, in which a single photoelectric cell is called upon to produce the many thousands of separate impulses that are required to be transmitted through the line wire per second, a condition which no known form of photoelectric cell will admit of.

Again, it may be pointed out that sluggishness on the part of the metallic cubes in J or of the vapour in K, in acting photoelectrically, in no wise interferes with the correct transmission and reproduction of the image, provided all portions of the image are at rest; and it is only to the extent that portions of the image may be in motion that such sluggishness can have any prejudicial effect. In fact, sluggishness will only cause changes in the image to appear gradually instead of instantaneously.

Many modifications are, of course, possible in detail. For instance, the plate O of the receiver might perhaps better be replaced by an electromagnet or solenoid so arranged as to repel the kathode beam when energised. Again, the somewhat crude form of photoelectric cell described, composed merely of insulated cubes of rubidium in contact with sodium vapour, might be improved upon. Indeed, it is highly probable that research will reveal much more sensitive materials, the use of which would vastly improve this part of the apparatus, which at present is probably the one least likely to give the desired results.

GEOGRAPHY OF BRITISH CENTRAL AFRICA.[1]

ATTENTION was first directed to "British Central Africa" by Dr. Livingstone in 1859. By the term "British Central Africa" I mean the present protectorate of "Nyasaland," together with north-eastern Rhodesia; that is, the British territory bordering on the Shire River, and on Lakes Nyasa, Tanganyika, Mweru, and Bangweulu.

Records show that the Portuguese had some knowledge of the Nyasa regions so far back as the seventeenth century, though they never established any stations there. They followed the line of "least resistance," the Zambezi River, which was navigable for small craft up to the Kebrabasa rapids. It may be taken as practically certain that at the very ancient period when at "Zimbawe" and elsewhere in Mashonaland there existed a flourishing gold-producing industry, the River Zambezi was known and navigated by the same ships which brought traders to the port of Sofala. No ancient rock-workings for gold have been found north of the Zambezi similar to those in Mashonaland, but it is not improbable that the traders of those days obtained copper from Katanga, and used the Zambezi as their most available transport route. With regard to the ruins in Mashonaland, no African race unaided ever erected these stone buildings, nor, in my opinion, can they be dated back to anything but the most ancient times. The idea that Solomon got his gold there has sometimes been ridiculed; but why not? We know that in those times fleets were sent out from the Red Sea periodically, which returned with gold, apes, ivory, and feathers—all products of Africa. These ships were probably identical with the Red Sea dhows of to-day. Where would explorers with vessels of that type be likely to go first, on leaving the Red Sea? Out into the Indian Ocean? or down the African coast? They would, of course, follow down the land; and whether or not in King Solomon's days he got his gold from the east or the south, it may be taken as certain that the whole East African coast was then known and frequented by traders. It is interesting to note that the question as to who were the ancient people who worked the gold-mines of South-east Africa is no new one. In that fascinating book, "A History of Africa," by John Ogilby, published in 1670, the matter is thoroughly discussed, and the arguments for and against King Solomon are fairly stated. Ogilby says, in speaking of the kingdom of Monomotapa: "In this country far to the inland on a plain stands a famous structure called Zimbawe, built square like a castle with hewn stones of a wonderful bigness. Above the gate appears an inscription which cannot be read or understood, nor could any that had seen it know what people used such letters. Near this place are more such buildings by the same name, signifying a court or palace. The inhabitants report it a work of the devil, themselves only building with wood." Also, as regards Sofala, he says: "The inhabitants aver that this is the very true Ophir from whence King Solomon had his gold." Then follows a full statement of the arguments *pro* and *con*.

The geographical position of Nyasaland is a somewhat remarkable one. The Shire valley and Nyasa form the southern portion of one of the greatest "rifts" in the African continent. This depression, after a break north of the lake, is carried on for 400 miles by Lakes Rukwa and Tanganyika, and, with a few short breaks, runs on by Lakes Kivu, Albert Edward, and Albert, to the Nile valley. Following this route, a journey by boat could be made from the mouth of the Zambezi to the Mediterranean, a distance of more than 4500 miles, covering 50 degrees of latitude, with a total distance of land portages of not more than 500 miles. A curious point about this great line of depression is that for a great part of its length it lies almost alongside the backbone of tropical Africa, the watershed in some parts approaching within a few miles of the lakes which lie along its course.

Most of British Central Africa has an average elevation of some 3000 to 4000 feet above sea-level. Here and there are higher plateau masses and peaks, which in some cases rise to close on 10,000 feet. The most notable of these plateaux are "Nyika" in the North Nyasa district and "Mlanje" in the Shire Highlands. The former has an average altitude of 7000 to 8000 feet with an area of 2000 square miles, and a European climate; the Mlanje plateau lies at 6000 to 7000 feet, and has an area of some 250 square miles. Both are what Sir Harry Johnston used to call "Jack and the Beanstalk" countries, the plateau sides rising precipitously from the surrounding country, and being almost unclimbable. On Mlanje grows the *Widdringtonea whytei* (Mlanje cypress), a large handsome conifer, a very valuable timber of excellent quality, durable and impervious to the attacks of white ants.

[1] From a paper on "The Geography and Economic Development of British Central Africa," read before the Royal Geographical Society on December 4, by Sir Alfred Sharpe, K.C.M.G., C.B.

British Central Africa is drained (*a*) by the Nyasa-Shire-Zambezi outlet, (*b*) the Loangwa-Zambezi, (*c*) the Luapula-Congo. That portion of the Nyasa-Tanganyika plateau which borders on the route of the "Stevenson road" drains in five directions: (1) To Lake Tanganyika and the Congo, (2) to Nyasa, (3) to the Chozi and Luapula, (4) to Lake Rukwa, which has no outlet, (5) to the Loangwa and Zambezi.

But while the bulk of this portion of Africa lies at elevations over 3000 feet, the two main drains to the south, Nyasa-Shire and Loangwa-Zambezi, form deep depressions of considerable width, not attaining an altitude of anything above 1500 feet in their northernmost (highest) parts. One result of this is that British Central Africa has two climates, that of the low country, hot and somewhat unhealthy, and that of the uplands, pleasant and fairly healthy.

When I first knew Nyasaland, in 1887, there was an available line of water transport some 700 miles in length from the Zambezi mouth to the north end of Lake Nyasa, with one break only, the Murchison cataracts of the Shire River (which extend for some 40 miles). During recent times the course of the Shire has so rapidly and persistently silted up, both above and below the cataracts, that at the present day the upper portion is almost unnavigable at any season, and the lower river, instead of being available as a transport route all the year round from the sea to the foothills of the Shire Highlands, can only be used for a few months of the year so far as the junction with the Ruo River. The Shire gathers very little water on its course, and is the overflow pipe from the Nyasa tank. When that tank almost ceases to overflow, as is the case at present, the pipe *must* be more or less empty, and no human power can fill it.

This enforced abandonment to a great extent of the Shire as a transport route has been a terrible handicap on the growing planting industries of Nyasaland, which at this moment is unable to find a means of transporting to the sea-coast the cotton, tobacco, rice, maize, tea, rubber, and other marketable articles she is actually producing. The suggested extensions of the railway north and south will enable the protectorate not only to deal with what she is now producing, but to open up large additional tracts of land.

For the present fall in level of Lake Nyasa, the result of which is a far scantier and only intermittent overflow into the Shire River, it is difficult to assign any reasonable cause except a decreased rainfall in the basin; but such observations and records as have been kept at lake stations during the last few years do not seem altogether to bear out this supposition. A theory which might to some extent account for definite cycles of rise and fall of the level of Nyasa (presumably due to lessening and increasing rainfall) has suggested itself to me, and I advance it for what it is worth. We are aware that Tanganyika has a natural outlet to the Congo. When Livingstone and Stanley were there this outlet was found (the Lukugu), but it was blocked up; it was clear from native evidence that the lake had been rising in level for a number of years. The prophecy was then made that sooner or later it would break out at its old outlet. This subsequently took place, and for years Tanganyika has sent its surplus waters to the Atlantic. I am not aware whether the Lukugu has yet closed again. A noticeable feature on Nyasa is an old beach-mark, 6 or 8 feet above the highest level to which the lake now rises. This mark is distinct and clear, especially on the rocks, and is carried round the lake both in the open and in the most secluded and sheltered bays. It is abundantly evident that at some not very distant time the lake had this higher level, from which there must have been a *sudden* fall. Some few years ago, during the dry season, Nyasa ceased to overflow, and the bed of the Shire River at its exit began to silt up, reeds and other plants took root, and natives were able to walk across with only a few inches of water here and there. It would only have needed a few similar seasons for the outlet to have become entirely choked up, as was the case with the Lukugu. Is it not probable, therefore, that this has actually taken place at previous periods, and that the level of the lake subsequently rose until it overflowed the barrier and finally burst it? Is it not, moreover, probable that these cycles of fall, blocking up, rise, and outburst have been going on for ages? A sort of recurring decimal.

The Nyasaland basin is very limited in extent. The bulk of the water which enters the lake comes in at its northern end from high country lying beyond the Anglo-German boundary. Part of this country consists of a very interesting volcanic district in "Kondeland," which is dotted over with the craters of extinct volcanoes. On the east side of Nyasa the watershed between the lake and the Indian Ocean lies within a few miles. No rivers of any size enter the lake from the east.

To refer to the climate of British Central Africa. Throughout the higher levels, from May to September inclusive, it would be hard to find a pleasanter climate. October and November are hot, but dry; December to March constitutes the rainy season; April is cool and finer (the finishing of the rains). Malaria is, of course, the chief trouble. If this could be checked there is no reason why the elevated plateaux, not only of British Central Africa, but of many other parts of tropical Africa, should not be as healthy as Queensland. Knowledge which has been gained during the last ten years, largely through the exertions of the London and Liverpool Tropical Schools of Medicine, has enabled us not only to get a very much better insight into the causes of malarial fevers, but also to some extent to prevent their occurrence. Most tropical diseases are now known to be communicated by various biting insects, and if it were possible to protect ourselves against the attacks of these we should be able to prevent fevers. The difficulty, however, is to carry this out successfully.

A few years ago the first cases of sleeping sickness were discovered in British Central Africa. The disease reached this part of the continent from the Congo State, having, no doubt, been carried to the shores of Tanganyika and Mweru, and to the Luapula Valley, by the numerous expeditions from the Congo to the eastern boundaries of the Free State. It quickly established itself on Tanganyika and Mweru and in the Luapula Valley, also along the banks of several of the larger rivers running into Mweru and Tanganyika. Quite recently cases have appeared in the valley of the Luangwa, and also in the country bordering on the south-western shores of Lake Nyasa; and it is evident that there is in this part of Africa some hitherto unknown agent which carries the germ of sleeping sickness, as the tsetse-fly known as *Glossina palpalis* does not exist in the protectorate of Nyasaland (although it is found on Lakes Tanganyika and Mweru). More than one expedition is now at work investigating these interesting questions, and especially as regards the connection between tsetse-fly and big game. Whatever the results obtained by these expeditions may be, however, it is, I think, already evident that sleeping sickness will not prove to be such a scourge in these parts as it has been in Uganda.

It has been believed by many that the presence of game, and especially buffalo, is responsible for the existence of tsetse-fly. After many years spent in travelling over every part of Nyasaland and much of northern Rhodesia, Portuguese and German East Africa, and the Upper Congo, I arrived at the conclusion that the weight of evidence is against this theory, so far as tropical Africa is concerned; and in this belief, namely, that *tsetse in these regions does not depend on big game for its existence*, I think that all who are entitled to speak with authority, including Mr. Selous, are now agreed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE annual prize distribution and students' conversazione of the Northampton Polytechnic Institute, Clerkenwell, E.C., will be held to-morrow, December 8. Sir William H. White, K.C.B., F.R.S., will distribute the prizes and certificates.

THE organising committee for the Imperial University Congress to be held in London next July has appointed Dr. Alexander Hill, formerly Master of Downing College, Cambridge, to be secretary to the congress, in succession to the late Dr. R. D. Roberts.

A STUDY of the calendar for the session 1911–12 of the University College of North Wales emphasises how much has been accomplished in recent years in making more easily available the advantages of higher education. It can no longer be said that university education is possible only for the child of wealthy parents. The present calendar shows that the fees of an ordinary arts student at the University College of Bangor amount only to 13*l.* 1*s.* per session, and of a science student to 17*l.* 1*s.* per session. The total cost of living in lodgings and tuition in Bangor averages from 35*l.* to 45*l.* for the session.

THE annual meeting of the trustees of the Carnegie Foundation for the Advancement of Teaching was held in New York on November 17. According to a Press notice, says *Science*, Mr. Carnegie gave 200,000*l.* of the 1,000,000*l.* which he had promised in case the State-supported institutions were admitted to the benefits of the foundation. The endowment is 2,425,200*l.*, yielding an annual income of 118,000*l.* Last year, it is said, the sum of 105,200*l.* was paid for pensions to 370 professors and widows of professors. Forty-eight were added to the list for the year, and fifteen died. The University of Virginia was added to the list of accepted institutions.

THE fourth annual dinner of the old students of the Royal College of Science, London, will be held at the new Imperial College Union, Prince Consort Road, South Kensington, on Wednesday, December 13. Sir Alexander Pedler, F.R.S., president of the Old Students Association, will preside; and the guests will include the President of the Board of Education, the Rt. Hon. A. H. D. Acland, Sir Robert Morant, K.C.B., Sir Arthur Church, K.C.V.O., Sir Alfred Keogh, K.C.B., Prof. S. H. Cox, and Prof. W. E. Dalby. Tickets for the dinner may be obtained on application to the secretary of the Old Students Association, 3 Selwood Place, S.W.

IT was proposed recently that steps should be taken to establish a University of Brighton, and a meeting is to be held on Tuesday next, December 12, by invitation of the Mayor of the town, to consider the subject. It is suggested that there might be affiliation with the Municipal College at Portsmouth and the Hartley University College, Southampton, to constitute a new university for the South Coast, or that the present radius of the University of London should be extended to include the proposed new University College. Hitherto, Brighton has not shown any very marked desire to take a prominent part in technical or university education. The town has a population of 131,000, yet there are only between sixty and seventy day students in the Municipal Technical College, and nearly two-thirds of these are first-year students. This does not provide a very promising nucleus upon which to constitute a university or a university college, or indicate keen local interest in higher education. We should be sorry, however, to discourage the proposal, and we trust that next Tuesday's meeting will lead to the formation of a scheme which will be successfully carried out in due course.

THE report of the council of the Royal Agricultural Society, adopted at the annual general meeting held yesterday, contains, among other interesting particulars, information concerning certain alterations in the regulations and syllabuses of the society's examination in agriculture. The National Agricultural Examination Board is of opinion that the time has arrived when the practice of examining in elementary science might be discontinued, and the subjects of examination will in future be:—practical agriculture (two papers), farm and estate engineering (including surveying, buildings, machinery, and implements), agricultural chemistry, agricultural botany, agricultural book-keeping, agricultural zoology, and veterinary science. Candidates will have the option of taking the whole eight papers in one year, or of sitting for a group of any four in one year, and the remaining group of four in the next year. In order to be eligible to sit for the new examination, a candidate must present a certificate from a recognised agricultural college that his attainments in the subjects of general botany, general chemistry, geology, and physics and mechanics, as attested by class and other examinations, are, in the opinion of the authorities of the college, such as to justify his admission to the examination.

So much attention has been directed during the year to the question of the legitimate place of public examinations in our system of education that a special interest is attached to an unsigned article in the Journal of the Royal Society of Arts of November 10 on the number of candidates offering themselves for the public examinations held during the year 1910. It appears that some 300,000 pupils were examined, without counting students presenting themselves for university and professional examinations and all the competitive examinations for the Army, Home and Indian Civil Services, and so on. This very large total included about 23,000 candidates in each case for the Local examinations held by the Universities of Oxford and Cambridge, some 6000 for the London Matriculation examinations, about 113,500 for the science and art examinations of the Board of Education, 24,500 for the technological examinations of the City and Guilds of London Institute, 11,500 for the London Chamber of Commerce examinations, 9000 for those of the College of Preceptors, about 14,500 for those of the National Union of Teachers, 42,000 for the examinations of the Lancashire and Cheshire Union of Institutes, and more than 27,000 for those of the Royal Society of Arts. As the writer of the article remarks: "Most people will admit that, whether examinations are or are not desirable, the thing is somewhat overdone."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 23.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir Norman **Lockyer**: The iron flame spectrum and those of sun-spots and lower-type stars. Previous publications are referred to indicating that the spectral lines of the metallic elements have been separated into two series, one seen best in the hotter stars and when high temperature and great electric energy are employed. These were termed "enhanced lines." The other set, existing in stars of the solar type, but not in high-temperature stars, and seen with lower degrees of heat and electric energy in the laboratory, were called "arc lines." These lines have been shown to be strengthened in sun-spot spectra, while the enhanced lines are weakened. It seemed important to consider as a third term the spectrum given by the comparatively low temperature of the oxyhydrogen flame and see how the lines in the spectrum behave in the spectra of sun-spots and lower-type stars. Photographs have been recently obtained of the oxyhydrogen flame spectrum of iron, using greater dispersion than has hitherto been employed on that spectrum at Kensington. It has been found that the lines existing in the flame spectrum nearly all behave in a similar way in sun-spot spectra, these lines being extensively winged in passing from the Fraunhoferic spectrum to the sun-spot spectrum, and, generally speaking, more conspicuous in the latter. It has also been found that the flame lines are just those which are relatively strong in the electric furnace spectra of iron, the spectrum furnished by the lowest temperature conditions dealt with in the furnace being almost identical with the oxyhydrogen flame spectrum. With regard to the behaviour of the flame lines in the spectra of lower-type stars, it is found that in the region λ 4000 to λ 4330 they are mainly unaffected in the spectrum of Arcturus. In the region λ 4330 to λ 4500 the evidence tends to show that most of the lines are strengthened both in Arcturus and α Orionis, but this point cannot be definitely established until stellar spectra of greater dispersion are available.—Sir Robert **Hadfield**: Sinhalese iron of ancient origin. There being little definite evidence regarding ancient iron, the author describes some specimens from the buried cities of Ceylon. His paper supplements one by Dr. G. Pearson, read to the society in 1795, on Indian steel of modern manufacture. The specimens investigated, obtained through the kindness of the Governor-General of Ceylon, Sir Henry McCallum, are (1) a steel chisel, fifth century A.D.; (2) an ancient nail, probably of same place and date; (3) a bill

hook. This date has been verified by Dr. A. Willey, F.R.S. Examination of the chisel showed—

Composition:	C	Si	S	P	Mn	Fe	Specific gravity.
	traces	0·12	0·003	0·28	nil	99·3%	7·60

Difference being slag and oxide.

Frémont shear test showed 16 tons per square inch elastic limit, 26 tons per square inch breaking load. Shock test showed 17 kg. with 85° bend before breaking. Brinell ball test showed hardness numbers 144 and 144 on opposite sides. Scleroscopic hardness, 35. Transverse section shows the specimen to be somewhat carbonised, with carbonised areas on two sides. The presence of martensite and hardenite suggests the important information that the chisel was quenched. The analyses in the paper probably represent the only modern complete determination of the composition of authentic specimens of ancient iron. The percentage of phosphorus, though high, does not greatly differ from modern bar iron. Sulphur is extremely low, showing the employment of a very pure fuel. There is very little silicon, while manganese is entirely absent, which is somewhat remarkable, since nearly all iron contains some manganese. From microscopical examination and other tests it results that the specimens represent wrought iron rather than steel. They somewhat resemble puddled iron, and seem to have been made from rather impure ore. The percentage of carbon is low, as is the case for other impurities, with the exception of phosphorus. Slag is present in considerable quantity in a lumpy, irregular form, indicating that the material was not submitted to the amount of forging undergone by modern wrought iron.—Prof. J. S. **Townsend**: The conductivity of a gas between parallel plate electrodes when the current approaches the maximum value.—Hon. R. J. **Strutt** and A. **Fowler**: Spectroscopic investigations in connection with the active modification of nitrogen. II.—Spectra of elements and compounds excited by the nitrogen. The chief results are as follows:—(1) The spectra generated by the nitrogen afterglow do not differ fundamentally from those which can be produced by other means of excitation. In many cases, however, band spectra are better displayed, and the more refrangible parts of the spectrum are more completely developed. The method therefore adds to our resources for the production of spectra. (2) The spectra of metallic substances approximate to those obtained in the electric arc, or are intermediate between arc and flame spectra. (3) The band spectra given by iodine, chloride of tin, and mercuric iodide are very similar to those obtained from vacuum tubes. (4) The spectra exhibited by sulphur, sulphuretted hydrogen, and carbon disulphide consist of bands which are quite distinct from those given by sulphur in a vacuum, but resemble the bands of the carbon disulphide flame in air. (5) The cyanogen spectrum which is developed in the glow by cyanogen and certain other compounds of carbon differs in several respects from that observed in the cyanogen flame or carbon arc. Some of the differences appear to be due to the production of the spectrum at a relatively low pressure in the glow. A new set of bands, occupying positions near the most refrangible edges of the violet groups, occurs in the glow spectrum, and has also been observed during the phosphorescent combustion of cyanogen in ozone.—A. **Fowler** and H. **Shaw**: The less refrangible spectrum of cyanogen, and its occurrence in the carbon arc. (1) Revised wave-lengths are given for the bands forming the less refrangible part of the cyanogen spectrum. Numerous bands which have not previously been recorded are included. (2) The heads of the bands can be arranged in regular series similar to those constituting the first positive band spectrum of nitrogen. (3) There are considerable variations in the relative intensities of the various bands, according as the spectrum is obtained from the flame of the burning gas, from a vacuum tube, or from the luminous glow produced by the interaction of certain compounds of carbon with active nitrogen. (4) The complex spectrum of the carbon arc in the red and yellow is almost entirely due to cyanogen. (5) The spectrum of cyanogen in the sun is not of sufficient intensity to give visible indications of the red and yellow bands.—Sir W. **Ramsay**: Note on the monatomicity of neon, krypton, and xenon.—H. M. **Budgett**: The adherence of flat surfaces. This paper deals with the various causes producing adherence between plane surfaces which have simply been "wrung" together, and experiments are described which were carried out with specially prepared steel gauges. It is shown that the effects of atmospheric pressure and molecular attraction between the opposing faces are very slight, and that the adherence is chiefly due to the presence of a minute liquid film between the gauges. Tables are given comparing the force required to pull the gauges apart when various liquid films were present, and also comparing the readings obtained when separation occurred in air and in a vacuum. Photomicrographs are shown illustrating the distribution of a paraffin film over the steel, and proving that only a small area of the faces is covered by the liquid. The breaking strains of various liquids are estimated from microscopic measurement of the area of cross-section under strain, and it is shown that the tensile strength of water approaches ... atmospheres under these conditions.—G. D. **West**: The resistance to the motion of a thread of mercury in a glass tube. It is shown by theory and experiment that if a mercury index is to be moved along a glass tube of small bore with a velocity v, the difference of pressure P on the two ends of the index is given by

$$P = 0{\cdot}038/a + 8l\eta v/a^2,$$

when a is the radius of the tube and η the coefficient of viscosity of mercury.—A. J. **Berry**: The distillation of binary mixtures of metals in metals *in vacuo*. Part I.—Isolation of a compound of magnesium and zinc. Attempts have been made to isolate definite compounds of two metals, one of which, at least, is readily volatile, by distillation of the excess of the more volatile constituent; compare Heycock and Neville (Trans. Chem. Soc., 61, 1892, p. 914). In the present case it has been shown that the compound $MgZn_2$ discovered by Grube (*Zeitsch. anorg. Chem.*, 49, 1906, p. 77) can be prepared by heating a mixture of magnesium with an excess of zinc *in vacuo*. The excess of zinc distils off, and the residual alloy consists of the intermetallic compound. It has further been shown that this compound can be distilled without decomposition. —F. J. **Selby**: Analysis of tidal records for Brisbane for the year 1908. This paper gives the results of an analysis of one year's tidal records for Brisbane. The analysis was made by the method of Sir G. H. Darwin, the tidal abacus devised by him being employed. The results are generally in good agreement with those given by Rolin A. Harris for Sydney, as deduced from a year's observations of high and low waters. Using the constants given by the analysis, a curve was run off on the Indian tide-predicting machine at the National Physical Laboratory, and from a comparison of this with the actual records it was concluded that the values of the constants obtained were satisfactory.—Henry E. **Armstrong**, E. Frankland **Armstrong**, and E. **Horton**: Herbage studies. I.—*Lotus corniculatus*, a cyanophoric plant. Early in the summer last year plants of *Lotus corniculatus* growing on the Thames banks near Reading were found to contain a cyanophoric glucoside, but hydrogen cyanide could rarely be detected in plants from various localities collected later in the season. This year specimens have been obtained from a great variety of British localities, and these have rarely been tested without obtaining positive results. The climatic conditions during the two seasons have been very different, so that the differences observed between plants grown in the two years would seem to be mainly due to climatic differences. This year plants have also been obtained from all over Europe—from Norway, France, Holland, Germany, Russia, Servia, and Italy. In no case was cyanide found in plants growing in Norway, where the conditions have been such as to favour luxuriance rather than "maturity" of growth. The specimens obtained from other European localities in a majority of cases contained cyanide. The glucoside is usually accompanied by a corresponding enzyme, but this may occur without the glucoside. Wherever collected, the variety of *L. corniculatus* known as *major* (*uliginosus villosus*) has been found to be free from glucoside and enzyme; it would therefore seem that

otanists are justified in ranking this form as a distinct pecies.—B. **Hopkinson**: A high-speed fatigue tester and ie endurance of metals under alternating stresses of high equency. In this apparatus the test-piece (¼″ diameter y 4″ long) is fixed vertically, the lower end being attached heavy masses. The upper end of the piece carries a eight. The weight is attracted by an electromagnet laced above it and excited by alternating current. The ull thus applied varies periodically between zero and a aximum value, the frequency of the variation being vice that of the current. The test-piece behaves as a pring, the lower end of which is held fixed, while the pper end carries the weight and is free to move in a ertical direction. The adjustments are such that the atural period of vertical oscillations of this system is pproximately equal to the period of the varying magnetic ull, which accordingly sets up large forced oscillations of s own period. By thus using the principle of resonance ith a current frequency of 60 periods per second the nge of pull applied by the magnet may be magnified from to 70 times, and the stress produced in the piece can adily be made to alternate between 20 tons per square ch tension and 20 tons per square inch compression. he number of complete cycles per minute is 7200, and 000,000 reversals can be performed in 2½ hours. The st-piece is fitted with a simple form of optical extenso-eter whereby continuous observation can be kept of the ange of length occurring in a cycle of stress. From the ange of length the stress can be calculated if the piece approximately perfectly elastic under the stress which being applied. An independent estimate of the limits of ress can also be obtained by observing with a microscope e range of movement of the weight and calculating its cceleration from that range on the assumption (the justifi-ition of which is fully discussed in the paper) that the otion is simple harmonic. These two methods of getting e stress were found to agree closely for the mild steel sed in the experiments up to a range of stress of about tons per square inch. Endurance tests made in the ew machine on mild steel showed that the steel would and at least twenty million cycles of stress covering a nge of 29 tons per square inch. Comparative tests of e same steel made by Dr. Stanton at the National hysical Laboratory in a direct-stress testing machine ving about 1100 reversals per minute showed that at this eed the probable life of the material under the same nge of 29 tons per square inch would be less than o,000 reversals. Similar comparisons with both higher d lower ranges of stress confirmed the conclusion that at e high speed of more than 7000 reversals per minute the durance is much greater than at 1100 reversals per inute, both in the number of cycles and in the actual ne required to produce fracture.

Royal Meteorological Society, November 15.—Dr. H. N. ickson, president, in the chair.—C. **Harding**: The normal weather of the past summer. The author pre-nted statistics showing the distribution of temperature, infall, and sunshine week by week in the various districts the British Isles, and also made a comparison of the sults with the Greenwich Records back to 1841. From e facts thus brought together, Mr. Harding showed that far as temperature is concerned the summer of 1911 was ique. The maximum temperature of 100° at Greenwich August 9 is the highest temperature recorded in the ritish Isles since the establishment of comparable ob-rvations. The mean temperature for the summer was also gher than for any similar period during the last seventy ars. The maximum temperature of 96° in July has only en slightly exceeded on two previous occasions, and the ptember temperature of 94° has not previously been ualled during that month. So many hot days during the mmer have never before been recorded. Mr. Harding rther showed that the rainfall for the three summer onths has only been smaller in three previous years during e period of seventy years, and also that the duration of ight sunshine was greater than in any previous summer ice the introduction of sunshine recorders in 1881. As a nsequence of the exceptional weather the harvest was erywhere commenced at an earlier date than usual, and as quickly concluded under the most favourable conditions. The effects of the drought, other than in relation to the water supply and vegetation, were very far reaching. —W. **Larden**: Observations of solar halos.

Zoological Society, November 21.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—Dr. Geoffrey **Smith**: The fresh-water crayfishes of Australia. The object of this paper was to revise the classification and nomenclature of the Australian and Tasmanian crayfishes, and to give diagnoses of the genera and species with their limits of distribution. The work was based on a large material obtained from all parts of the continent and from Tasmania. Many of the specimens had been collected by the author, but the majority formed a very large collection brought together during the past twenty years by Prof. Baldwin Spencer. Four genera were recognised, Astacopsis, Chærops, Parachærops, and Engæus; the first three genera included the fresh-water crayfishes proper, and the last-named genus contained the land crayfishes, which were not dealt with in this paper. The geographical distribution of these genera and its bearing upon the geographical problems of Australia was discussed, and the view was supported that the Bassian subregion represented the home of the Australian crayfish, and that Astacopsis was nearest the ancestral form.—F. E. **Beddard**: A new genus of tapeworms from the bustard (*Eupodotis kori*). Four complete specimens and some fragments of this cestode had been obtained from a South African bustard in the society's gardens, and the author regarded it as a member of the group Tetracotylea, but could not reconcile its characters with those of any other genus of that group at present known. He briefly described its anatomical characters and discussed its systematic position, and proposed a new genus and species for its reception.—A. E. **Cameron**: The structure of the alimentary canal of the stick-insect, *Bacillus rossii*, Fabr., with a note on the parthenogenesis of this species. The author stated that this insect had a rather limited distribution, occurring in the south of Europe and in the north of Africa, and that in the wild state it was not found north of Orleans. Certain peculiarities of the alimentary canal were dealt with which were regarded as adaptations to the mode of life of the species. Attention was directed to the fact that the male was only rarely found in the wild state, and that parthenogenetic reproduction of *B. rossii* had been verified, for during four generations the specimens kept by the author had showed no males. The fact that the males were disappearing suggested that parthenogenesis was not the primitive method of reproduction, but that the species had become adapted to it through the failure of sexual reproduction.—H. B. **Preston**: A collection of terrestrial and fluviatile shells made by Mr. Robin Kemp in British and German East Africa. One new genus and thirty-four new species were described, which represented only a very small portion of the large number of species collected.—G. A. **Boulenger**: The habits of British frogs and toads. The paper gave information for those who might feel inclined to carry out further observations on the subject of the migrations of Amphibia as dealt with in a paper recently read before the society. The common toad was strongly recommended as the most suitable batrachian on which to institute series of experiments on distant orientation.—R. **Lydekker**: Milk-dentition of the ratel. The author described an instance of primitive features present in the milk-dentition being entirely lost in the teeth of the permanent series. So far as he was aware, no such atavistic feature had been hitherto recorded in the case of any existing mammals.

Geological Society, November 22.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. T. G. **Bonney**, F.R.S., and Rev. E. **Hill**: Petrological notes on Guernsey, Herm, Sark, and Alderney. Further study has been given to the relations of the igneous masses. The old distinction between diorite and syenite cannot be maintained; there exists, especially in Guernsey and Alderney, a dioritic magma, which underwent differentiation. The results of this are described, the most basic being found at Fort Albert (Alderney) and Bon Repos Bay (Guernsey), and the most acid, which are really tonalites, in the north-west of the latter island. These and a felspathic variety

sometimes intrude, sometimes pass into the others, so they also must have been at high temperature. The so-called "granites" at the two ends of Sark are hornblendic, the southern one being really a tonalite; so are those of Alderney, Herm, Jethou, and Guernsey, and it is suggested that these granites may be yet more acid terms in a differentiation series. Of the numerous dykes, the most acid are either aplitic micrograpites or quartz-felsites. Diabase-dykes are common, and mica-traps have been found in all the islands except Herm. At Pleinmont, in the south-west of Guernsey, a mass resembling a greenstone proves to be sedimentary. The time-relations of the several rocks are discussed. The gneiss of Guernsey is the oldest, and had acquired its structure before the intrusion of the diorites. They were followed by the hornblendic granites, and these by the aplitic micrograpites. All were pre-Cambrian. The date of the diabase-dykes is more uncertain. The mica-traps are probably late Palæozoic.—H. **Woods**: The evolution of Inoceramus in the Cretaceous period. The species of Inoceramus found in the Gault, the Upper Greensand, and the Chalk are considered to have descended from two stocks which occur in the Lower Greensand, one being *I. salomoni*, d'Orb., the other of the type of *I. neocomiensis*, d'Orb. (1) *I. concentricus*, Park. (Lower and Upper Gault), is of the same type as *I. salomoni* (Folkestone beds and Mammillatum bed), from which it has been derived. *I. sulcatus*, Park. (Upper Gault), closely resembles *I. concentricus*, except that it possesses strong radial ribs. Between these two species every gradation is seen. *I. tenuis*, Mant. (Red Chalk and Chalk Marl), is allied to *I. concentricus*, from which it has been derived by an increase in the length of the hinge and a decrease in the prominence of the left umbo. (2) *I. anglicus*, Woods (Gault and Upper Greensand), resembles *I. neocomiensis*, but the posterior part of the shell has become more compressed, and the ventral curvature of the ribs has increased. From *I. anglicus* two species appear to have arisen, namely, *I. pictus* and *I. crippsi*. (*a*) *I. pictus*, Sow. (Chalk Marl to *H. subglobosus* zone), approaches the form of *I. anglicus*, which has more numerous and more regular ribs; and in it the ribs have become still more numerous and more regular, and the anterior area has become more extensively developed. (*b*) *I. crippsi*, Mant. (Upper Greensand to zone of *H. subglobosus*), agrees in many respects with the form of *I. anglicus*, which has fewer and less regular ribs; but in this species the hinge has become somewhat shorter, the postero-dorsal part of the shell less compressed, the anterior area smaller, the ribs fewer and more irregular, with a less strongly marked posterior curvature.

CAMBRIDGE.

Philosophical Society, November 13—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—Sir J. J. **Thomson**: Application of positive rays to the study of chemical reactions. The author describes the results of the application to chemical reactions of a method which he brought before the notice of the society at a previous meeting. The production of carbon monosulphide when an electric discharge passes through the vapour of carbon bisulphide was detected by this means. The author gives the results of investigations on the chemical combination between hydrogen and oxygen and hydrogen and nitrogen, and discusses the source of curves corresponding to atomic weights 1–6, 2–5, 20–21, 39, 50–51, which do not fit in with recognised elements or compounds.—N. **Bohr**: Electron theory of metals. In the paper an attempt is given to generalise the theory of H. A. Lorentz, retaining, however, the main assumptions used by this author. It is shown that, by making alterations in the special assumptions used by Lorentz, results can be obtained for the electric and thermal conductivities and for the galvano-magnetic phenomena, which agree more closely with the experiments. On the other hand it is shown that the calculation of the absorption and emission of heat rays with long times of vibration in all the considered cases leads to the same law of heat radiation as given by Lorentz, and that, further, the remarkable conformity between Lorentz's calculation of the thermoelectric phenomena and the thermodynamic theory of these phenomena given by Lord Kelvin will remain unchanged in all the considered cases. Finally, it is shown that the presence of free electrons, contrary to the generally adopted opinion, will not give rise to any magnetic properties of the metals.—J. C. **Chapman**: Secondary characteristic Röntgen radiation from elements of high atomic weight. The secondary Röntgen radiation has been examined from lead which belongs to the more or less unknown second group (group L, Barkla, *Phil. Mag.*, September) as regards its characteristic radiation. It was found that lead shows a marked homogeneous constituent mixed with the scattered radiation. λ/ρ in Al=16·8 ($I = I_0 e^{-\lambda x}$, ρ=density of Al). The absorption by the element lead in the form of lead oxide was measured for a series of homogeneous beams of group K, and it was shown that lead exhibits a marked selective absorption in the region where it commences to be excited; thus between selenium, $\lambda/\rho=18·5$, and bromine, $\lambda/\rho=16·3$, the ratio of the absorption by lead to that by aluminium commences to rise, and continues to do so until the absorption band is passed. This would suggest that the mechanism of production and the resulting radiation in both groups is of the same type.

EDINBURGH.

Royal Society, November 13.—Prof. J. C. Ewart, F.R.S., in the chair.—Angus B. **Fulton**: Experiments to show how failure under stress occurs, its cause, and comparative values of the maximum stresses induced when timber is fractured in various ways. The objects of the research were to study the effects of the medullary rays on the strength of timber when strained in various ways, and to connect up the maximum induced stresses in cross bending with those obtained in tension and compression. Some of the conclusions arrived at were that the initial cause of fracture lies in the medullary rays; that rectangular beams when laid on a tangential face are stiffer and have a higher fracture value than when laid on a radial face; that rectangular beams of unequal sides are stiffer, but not materially stronger, when laid on the broad side of the section; that fracture by shearing does not take place in timber beams of the commoner woods, supported on the two ends and loaded in the middle, where the ratio of span to depth of beam exceeds seven.—Dr. G. Rutherford **Jeffrey**: A new method of measuring mental processes in normal and insane people, with special reference to maniac depressive insanity. The object of the research was to ascertain whether or not any definite characteristics of the mental working process could be detected in the disease, or group of diseases, described as maniac depressive insanity. The reckoning test, recently described by Maloney, was used. The test consisted of the addition of digits in pairs, each pair being taken to represent a constant unit of mental work. Not only was the number of units of mental work done throughout a given period ascertained, but also the number of units per minute throughout the same period. The number per minute of these mental units was then plotted against the time, and a curve obtained showing objectively the mental working capacity throughout the period. The experiment consisted in allowing thirty cases of maniac depressive insanity to perform the reckoning test for fifteen minutes on each of five successive days. Seven normal people were tested under the same conditions and for the same length of time. An average normal mental curve was obtained in this way, and this was compared with the curves obtained from the insanity cases already mentioned. The normal curve did not support Hylans's assertion that the middle period of five minutes represented best the maximum working capacity. As compared with the normal curve, the work curve of the maniac depressive cases differed markedly in two ways:—(1) a tendency toward a high output characterised the third five-minute interval, which the author regarded as being probably due to the difficulty which such patients experience in getting under weigh in the mental task, and as being an expression of their exaggerated psycho-motor inertia; (2) the small extent of the terminal spurt, possibly due to the fact that the imminence of the end of the task, which acts as an incentive to greater effort in normal people, is not realised. The curves varied in form according as the patients were in the quiescent, depressed, or excited phases of the disease. For example, in the depressed patient's chart, the

recovery was performed in a series of steps, while in the excited cases the curve demonstrated incessant and abrupt transitions of mental energy in a morbidly excited brain. The author agreed with Maloney that the reckoning test was of distinct therapeutic, and possibly also diagnostic, value in psychiatry.—Prof. Alex. **Smith** and C. M. **Carson**: The freezing points of rhombic sulphur and of *soufre nacré*. When pure liquid sulphur freezes into the monosymmetric, the rhombic, or the *soufre nacré*, the freezing points are respectively 119·25°, 112·8°, and 106·8° C. When the liquid sulphur contains the insoluble sulphur in equilibrium, the freezing points become respectively 114·5°, 110·2°, and 103·4° C.

Paris.

Academy of Sciences, November 27.—M. Armand Gautier in the chair.—The president read a letter from Prince Roland Bonaparte putting at the disposition of the academy a sum of 250,000 francs to be used for facilitating research by young scientific men. It is not to be given in the form of a reward for work already done. The intention is that the amount should be given in five annuities to men who have already given proof of their capacity for original work, and, not being members of the academy, lack sufficient resources to pursue their investigations.—A. **Chauveau**: A phantom image of the Eiffel Tower observed in 1900. A detailed description of the phenomenon observed is given, together with an explanation as to its probable cause. It would appear to be analogous with the shadows known as the spectres of the Brocken.—M. Leclainche was elected a correspondant for the section of rural economy in the place of M. Eugène Tisserand, elected free academician.—F. A. **Forel**: The Fata-morgana. A discussion of the conditions under which this phenomenon appears on Lake Leman.—E. **Barré**: The minimum surfaces produced by a circular helix.—Emile **Cotton**: The instability of equilibrium.—M. **Jouguet**: The velocity and acceleration of waves of shock of the second and third species in wires.—André **Léauté**: Certain difficulties presented by the use of exponential developments.—J. **Danysz**: The β rays of the radium family. It has been shown in a previous communication that a glass tube containing radium emanation gives off at least seven bundles of β rays with different and determinate velocities. Fresh experiments on these rays have been carried out with a view to determine their velocities with the highest possible precision. Twenty-three bundles were distinguished, seven of which are strongly marked on the plate. The emanation from 0·3 gram of radium chloride was utilised for these experiments; the strength of the magnetic fields used varied from 600 to 6000 gauss.—Félix **Leprince-Ringuet**: The geometrical properties of the point representing the earth in the diagram of the voltages of a polyphase network.—G. Ter **Gazarian**: A general relation between the physical properties of bodies: application to viscosity, capillarity, surface energy, heat of vaporisation, and the rectilinear diameter. If q_1 and q_n are the quotients of the numbers representing the densities of bodies compared at temperatures t_1 and t_n, equally removed from the critical points, then the relation $q_n = q_1 + c(t_n - t_1)$ has been proved in a previous paper. The same equation has now been extended to other physical properties, the calculated and observed values of q showing a good agreement.—Albert **Colson**: The dissolecule and the formula of van 't Hoff. A reply to the criticisms of Girard and Henri. The author objects to the identification of osmotic pressure in solution with the pressure of gaseous molecules.—René **Dubrisay**: Chemical equilibria in solution. A study of the effect of the addition of acetone on the hydrolytic dissociation of bismuth nitrate.—L. C. **Maillard**: The condensation of the acid amines in presence of glycerol; cycloglycylglycines and polypeptides. A mixture of glycocoll with four or five times its weight of glycerol heated in a sealed tube to 170° C. gives a good yield of cycloglycylglycine.—J. A. **Le Bel**: The dimorphism of rubidium bichromate.—A. **Goris** and M. **Mascré**: The chemical composition of some of the higher fungi. Urea is present in some species and absent in others. Two cholesterols were also extracted, and a new substance, as yet not identified.—Paul **Macquaire**: Tyrosine as a fixing agent in the preparation of the iodopeptones.—H. **Labbé** and L. **Violle**: The ingestion of mineral acids in a dog from which the pancreas had been partially removed.—J. **Courmont** and A. **Rochaix**: The duration of immunisation, by the intestine, against experimental Eberthian infection in the rabbit. The immunity was found to be appreciable at the end of six months.—André **Lancien**: Electric colloidal rhodium. Starting with carefully purified rhodium, colloidal rhodium has been obtained by a modification of Bredig's method. The diameter of the particles of colloidal metal was about 5 $\mu\mu$. The colloidal rhodium solution was found to be without toxic properties when injected into fish, frogs, rabbits, and dogs, although the solution prevented the development of certain micro-organisms. Details are given of the application of this solution in therapeutics with beneficial results.—Etienne **Rabaud**: The cause of the isolation of solitary larvæ.—Edgard **Hérouard**: Parthenogenesic progenesis in Chrysaora.—M. **Rappin**: Antituberculous vaccination and serotherapy. Tubercle bacilli, after their virulence has been modified by a chemical treatment, are injected into the horse, from which a serum is prepared possessing a high agglutinating power. Experiments with this serum are described.—F. **Mesnil** and J. **Ringenbach**: The action of serums from the Primates on the human trypanosome of Rhodesia.—Carl **Renz**: The extension of the Trias in the middle portion of eastern Greece.—H. **Douxami**: The seismographic observation at Lille of the earthquake of November 16, 1911. The true displacement of the ground at Lille varied between 0·2 and 0·3 millimetre.

New South Wales.

Linnean Society, October 25.—Mr. W. W. Froggatt, president, in the chair.—R. **Greig-Smith**: Contributions to a knowledge of soil-fertility. No. iii., Bacterial slimes in soil. Many of the bacterial colonies that develop on saccharine media, after sowing with dilute suspensions of soil, contain gum or slime. As the bacteria actively produce the slime upon isolation, it is reasonable to suppose that their slime-forming faculty was being exercised while they were in the soil. Bacterial slimes, therefore, should be detectable in soils, if the conditions had been such as to prevent their decomposition. The investigation of a rich soil showed that slime was present; and, as it contained galactans which are typical of bacterial slimes, it probably had a bacterial origin.—A. H. S. **Lucas**: The gases present in the floats (vesicles) of certain marine algæ. The author, not having been able to find any account of actual analyses of the gases present in the floats of marine algæ, made a number of analyses of the gases found in the floats of *Phyllospora comosa, Hormosira banksii,* and *Cystophora monilifera*. In all cases, the gases consisted of oxygen and nitrogen only; in most cases the proportion of the oxygen was less than if air had been taken directly into the floats, and in all notably less than in air dissolved in water. In the floats of growing Hormosira, the proportion of oxygen was about 12 per cent. only of the total volume of contained gases. While there is no absolute evidence of the source of the gases, the author inclined to the view that they are derived from the air dissolved in the sea-water, the plant using up a considerable proportion of oxygen for its process of metabolism.—D. **McAlpine**: The fibrovascular system of the apple [Pome], and its functions. In a transverse section of the stalk of an apple, just as it enters the fruit, there are normally ten vascular bundles—or twelve if six carpels are present; eight if four—though sometimes two adjoining bundles may become confluent. These, on entering the fruit, spread out to form ten main trunks with numerous branches, and conveniently situated midway between the skin and the centre. The earliest branching and the most direct course is towards the carpels and the seed; then the flesh is supplied by numerous diverging branches, which unite to form a network of vessels, and finally terminate, beneath the skin, in a perfect maze of the most delicate forked veinlets. By macerating an apple in a weak solution of potassium hydrate for a week, and then removing the soft parts in water, with the aid of a brush and a needle, the fibro-vascular system may be isolated in a more or less intact condition. This system must not be conceived of as a vast network of tubes conveying food-material to a definite terminus, but as being tapped on the way by living tissue wherever growth is going on, or storage is required.

BOOKS RECEIVED.

Plane Trigonometry. By Prof. L. K. Ghosh. Pp. viii+271. (Calcutta: G. N. Halder.) Rs. 1/8.

Bergson. By J. Solomon. Pp. 127. (London: Constable and Co., Ltd.) 1s. net.

Cambridge County Geographies:—East London. By G. F. Bosworth. Pp. x+256. Monmouthshire. By H. A. Evans. Pp. x+183. Carnarvonshire. By Prof. J. E. Lloyd. Pp. xi+171. The Isle of Man. By the Rev. J. Quine. Pp. x+178. (Cambridge: University Press.) 1s. 6d. each.

Examples in Applied Mechanics and Elementary Theory of Structures. By C. E. Inglis. Pp. iii+77. (Cambridge: University Press.) 2s. 6d. net.

Morphologie Médicale. Étude des Quatre Types Humains. Applications à la Clinique et à la Thérapeutique. By A. Chaillou and L. MacAuliffe. Pp. iii+248. (Paris: O. Doin et Fils.) 5 francs.

Tierhaaratlas. By Dr. H. Friedenthal. Pp. 19+xxxv plates. (Jena: G. Fischer.) 40 marks.

The Wilderness of the Upper Yukon. A Hunter's Explorations for Wild Sheep in Sub-Arctic Mountains. By C. Sheldon. Pp. xxi+354. (London: T. F. Unwin.) 12s. 6d. net.

Reinforced Concrete Compression Member Diagram. By C. F. Marsh. (London: Constable and Co., Ltd.) 3s. 6d. net.

The British Journal Photographic Almanac, 1912. Edited by G. E. Brown. Pp. 1436. (London: H. Greenwood and Co.) 1s. and 1s. 6d. net.

Photographic Lenses. By C. Beck and H. Andrews. Seventh edition, completely revised, with index. Pp. 324. (London: R. and J. Beck, Ltd.) 1s. net.

Die Mechanik der Wärme. By R. Mayer. Herausgegeben von A. von Oettingen. (Ostwald's Klassiker der Exaktenwissenschaften, Nr. 180.) Pp. 90. (Leipzig: Engelmann.) 1.60 marks.

The Heat Treatment of Tool Steel. An Illustrated Description of the Physical Changes and Properties Induced in Tool Steel by Heating and Cooling Operations. By H. Brearley. Pp. xvii+160. (London: Longmans and Co.) 10s. 6d. net.

Psychic Phenomena, Science, and Immortality. By H. Frank. Pp. 556. (London: T. W. Laurie.) 10s. 6d. net.

Transactions of the American Institute of Chemical Engineers. Vol. iii., 1910. Pp. iv+406. (London: E. and F. N. Spon, Ltd.) 25s. net.

Poliedri, Curve e Superficie secondo i metodi della Geometria Descrittiva. By Prof. G. Loria. Pp. xv+235. (Milano: U. Hoepli.) 3 lire.

Entomology for Medical Officers. By A. Alcock, C.I.E., F.R.S. Pp. xx+347. (London: Gurney and Jackson.) 9s. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—Lapworthura: a Typical Brittlestar of the Silurian Age, with Suggestions for a New Classification of the Ophiuroidea: Miss I. B. Sollas and Prof. W. J. Sollas, F.R.S.—The Physiological Influence of Ozone: Dr. Leonard Hill, F.R.S., and M. Flack.—On the Factors Concerned in Agglutination: H. R. Dean.—The Action of Dissolved Substances upon the Auto-fermentation of Yeast: Dr. A. Harden, F.R.S., and S. G. Paine.—Further Experiments upon the Blood Volume of Mammals and its Relation to the Surface Area of the Body: Prof. Georges Dreyer and W. Ray.—The Origin and Destiny of Cholesterol in the Animal Organism. Part viii. On the Cholesterol Content of the Liver of Rabbits under Various Diets and During Inanition: G. W. Ellis and J. A. Gardner.

LINNEAN SOCIETY at 8.—The Internodes of Calamites: Prof. Percy Groom.—On Some Mosses of New Zealand: H. N. Dixon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on National and International Standards for Electrical Machinery: Dr. R. Pohl.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the Errors of Measurements on Photographic Plates: Winifred Gibson.—(1) Nouvelles étoiles doubles, 7me série; (2) Mesures d'étoiles doubles à l'Observatoire de Lille: R. Jonckheere.—Prevention of Dew Deposit on Glass Surfaces: J. Franklin Adams.—A Critical Comparison of the Overlapping Section of the Oxford and Potsdam Astrographic Catalogue: G. D. C. Stokes.—The Constitution of the Solar Corona. I. Protofluorine: J. W. Nicholson.—*Probable Paper:* The Determination of Differential Star-places by Photographic Methods: H. H. Turner.

MONDAY, DECEMBER 11.

VICTORIA INSTITUTE, at 4.30.—Natural Law and Miracle: Dr. Ludwig von Gerdtell.

ROYAL SOCIETY OF ARTS, at 4.30.—The Carbonisation of Coal: Prof. Vivian B. Lewes.

TUESDAY, DECEMBER 12.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Experiments on the Strength and Fatigue Properties of Welded Joints in Iron and Steel: Dr. T. E. Stanton and J. R. Pannell.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—A New Perigraph: J. Gray.

WEDNESDAY, DECEMBER 13.

ROYAL SOCIETY OF ARTS, at 8.—Continuous Service in Passenger Transportation: W. Yorath Lewis.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY OF ARTS, at 4.30.—The Fisheries of Bengal: Dr. J. Travis Jenkins.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Residence Tariffs: A. E. Seabrook.

CONCRETE INSTITUTE, at 8.—Some Recent Works in Reinforced Concrete: G. C. Workman.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Discussion:* Double cutting and High-speed Planing Machines: J. Hartley Wicksteed.—*Probable Paper:* Oil-burning Locomotives on the Tehuantepec National Railway, Mexico: R. Godrey Aston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests on Reinforced Concrete: E. F. Hunt.

CONTENTS.

THURSDAY, DECEMBER 14, 1911.

GÖTTERDÄMMERUNG.

The Golden Bough: a Study in Magic and Religion. By Prof. J. G. Frazer. Third edition. Part iii., "The Dying God." Pp. xii+305. (London: Macmillan and Co., Ltd., 1911.) Price 10*s*. net.

THE third part of "The Golden Bough" is an expansion of a portion of the third chapter of the second edition. Its title, "The Dying God," indicates the chief concern of the whole work, for it might well apply to four of the six parts. To the other three, "Adonis, Attis, Osiris," "The Man of Sorrows," and "Balder the Beautiful," it is related as genus to species.

Prof. Frazer is to be congratulated on having discovered the missing link, which he has long desiderated, in the chain of evidence required for his explanation of the fantastic rule of the priesthood of Nemi, which forms the text of his encyclopædic work. This discovery is one of the two chief portions of new matter introduced. Dr. C. G. Seligmann has discovered among the Shilluk of the White Nile a "coronation ceremony" which, in Prof. Frazer's cautious phrase,

"appears to be intended to convey to the new monarch the divine spirit of Nyakang, which has been transmitted from the founder of the dynasty to all his successors on the throne."

The practice of killing divine kings had been previously made out by the author, but the fact of succession to the soul of the slain monarch, though strongly suggested by many analogies, was still lacking. The Shilluk apparently supplied the omission.

The point calls for something more than mere mention, since it is of vital importance not only for the explanation of the Nemi priesthood, but for the general principles of the whole practice of superstitious regicide. A few extracts from Prof. Frazer's account will serve to make the point clear.

"The reverence which the Shilluk pay to their king appears to arise chiefly from the conviction that he is a reincarnation of the spirit of Nyakang, the semi-divine hero who founded the dynasty and settled the tribe in their present territory."

The religion of the Shilluk consists mainly of the worship paid to Nyakang. One of his most famous shrines is at Fashoda. Every shrine is called a grave of Nyakang, "though it is well known that nobody is buried there." Nyakang is the rain-giver of the country. Being incarnate in the reigning king, it is believed with "conviction" that the latter

"must not be allowed to become ill or senile, lest with his diminishing vigour the cattle should sicken and fail to bear their increase, the crops should rot in the fields, and man, stricken with disease, should die in ever-increasing numbers."

To prevent all this "it used to be the regular custom with the Shilluk to put the king to death whenever he showed signs of ill-health or failing strength." The old custom is said to have been the walling-up of the king in a specially built hut, where he died of hunger and suffocation. This custom "was abolished some five generations ago," and the Shilluk have adopted

"a quicker and more merciful mode. . . . What the exact form of execution has been in later times Dr. Seligmann found it very difficult to ascertain, though with regard to the fact of the execution he tells us that there is not the least doubt. It is said that the chiefs announce his fate to the king, and that afterwards he is strangled in a hut which has been specially built for the occasion."

Moreover, even while enjoying health and strength, the king might be attacked at any time by a rival.

"According to the common Shilluk tradition any son of a king had the right thus to fight the king in possession, and, if he succeeded in killing him, to reign in his stead."

In a note Dr. Seligmann is quoted as saying:—

"The assumption of the throne as the result of victory in single combat doubtless occurred once; at the present day and perhaps for the whole of the historic period it has been superseded by the ceremonial killing of the king, but I regard these stories as folk-lore indicating what once really happened."

At the investiture of the new king, a mysterious object called Nyakang is used. It

"is said to be of cylindrical shape. . . . The chief of Akurwa informed Dr. Seligmann that the object in question is a rude wooden figure of a man. . . . We may suppose that it represents the divine king himself, and that it is, or was formerly, supposed to house his spirit, though the chief of Akurwa denied to Dr. Seligmann that it does so now."

The object is placed on the royal stool, a leg of which is held by the king.

There is a lack of absolute certainty about the whole account. Dr. Seligmann has not seen the "Nyakang" nor a coronation. As for the residence of "the holy spirit of Nyakang" in the object bearing his name, all we have is the remark, "as Dr. Seligmann with great probability conjectures."

This method of crystallising dogmas out of the fluid ideas of barbarous thought is very characteristic of the inductive processes of the author. It may be said to constitute both his weakness and his strength. The rationalist may observe that the actuality of the Shilluk customs is mechanical common sense guided by the principle that might is right. The king must be a strong man both for his own and his people's sake. When a stronger man comes, he is liable to the incidence of this principle. When he himself decays, he is "relieved" of his duties, in the most effective way. Everything else is superstitious accretion, *ex post facto*, and of no practical importance. But when, as may happen in organised religions, such accretions crystallise into form, and are used as social or political levers upon the popular will, their importance may be far-reaching. Probably no one is better aware of this distinction than the author, but he has his own characteristic method of painting the social dangers of unscientific beliefs.

The other new subject in the volume has a similar aspect. This, put baldly, is the suggestion that the victors in the great Greek games were originally

"divine kings" and "dying gods." Victory in the race meant reigning for a term of years as an embodiment of the sun. Defeat at the end, a mark of senile decay, meant the death of the old, and the ascension of the new, god-man.

One may doubt whether early thought so welded together in actual practice the notions of god, king, priest, and man; but the ideas were a mixture, if not a compound.

The new matter thus, by emphasising the form of the inquiry, considerably increases its value, if we accept its form. This is the artistic side of the book, such as every scientific theory must possess.

The new edition of "The Golden Bough" is addressed to a new generation which has succeeded to the soul of a former generation impregnated with the teaching of the earlier editions. Its influence is certain to be proportionally cumulative and far-reaching.

A. E. CRAWLEY.

THE SCOURGE OF TROPICAL AFRICA.

A Handbook of the Tsetse-flies [*Genus Glossina*]. By E. E. Austen. Pp. x+110+x plates. (London: Printed by order of the Trustees of the British Museum. Sold by Longmans and Co., B. Quaritch, Dulau and Co., Ltd., and at the British Museum (Natural History), 1911.) Price 5*s.* 6*d.*

THE increasing attention which has been paid during the last few years to the collection and observation of tsetse-flies (Glossina) has led to the discovery of so many new species that the exhaustive monograph of this genus, published by Mr. E. E. Austen eight years ago, is now much out of date. The concise revision of the species by the same author now issued by the Trustees of the British Museum will therefore be most welcome to all who are concerned with the study of these formidable pests. In the original monograph only seven species were described, whereas now no fewer than fifteen are enumerated (excluding *Glossina maculata*, Newst., and *G. submorsitans*, Newst., to which the author does not accord specific rank), and two of these are described for the first time.

As a result of his examination of the male genital armature of all the known species, except *G. maculata*, Newst., and *G. fuscipleuris*, Aust., Prof. R. Newstead has shown that these structures present three markedly different types, which appear to afford a useful indication as to the mutual interrelationships of the species, especially as they coincide with the more important external distinctions. These sections he called respectively the *palpalis*-group, the *morsitans*-group, and the *fusca*-group. Mr. Austen has departed from this arrangement by dividing the last-named group into two, the only constant character given for separating these divisions being a difference in the tint of the wings. Wing-colour, however, has clearly no value as a group-character in this genus, and the proposed subdivision is open to the serious objection that it obscures the existence of important structural affinities, without any compensating advantage.

Apart from this, the synoptic tables for the determination of the groups and the species leave little to be desired. The preparation of a really accurate and workable key for a genus which presents but few salient and stable specific characters is by no means so simple a matter as it may appear, but with these tables any intelligent field worker should be able to determine his species without much difficulty.

Each species is fully dealt with under the following headings:—description, distribution, bionomics, and affinities and distinctive characters. The information given with regard to habits and life-histories indicates how very little we yet know of the bionomics of these insects, except in the case of two or three species. The puparia of six different species are now known, and these have all been figured (pp. 5 and 7). It is interesting to note that these structures exhibit distinctive specific characters, so that the discovery of even empty puparia may serve to throw some light upon the breeding habits of the various species.

From the point of view of a field worker this excellent handbook has only one drawback, namely, that no information whatever is given concerning the bionomics of the most important species, *G. palpalis*, the carrier of sleeping sickness; the reason adduced being lack of space. In these circumstances much of the unduly elaborate and highly technical description of the generic characters might well have been eliminated, while several pages have been wasted by the needless repetition of the synoptic tables.

The genus Glossina appears to attain its maximum development in the humid region of equatorial West Africa. From Southern Nigeria no fewer than nine different species have already been recorded, the Gold Coast coming next with eight. From Northern Nigeria five species are known, the remaining British colonies each having only four or less.

We may reasonably assume that all these insects are potentially capable of conveying serious diseases to men or domesticated animals, yet it must be admitted that so far no method has been devised for compassing their destruction in an effective manner. It is true that in certain places the clearing of forests has caused tsetses to withdraw, but this is a measure which is capable of only limited application, and might even defeat its object if done on too large a scale. As a rule, insect pests are most easily destroyed during the larval stage, but such a course is rendered impossible in the case of Glossina owing to the fact that the larva completes its development in the body of the mother. Thus we have to undertake the much more difficult task of destroying the perfect insect; and it is to be regretted that no serious attempts appear to have been made in the British colonies to test the method of trapping the flies with bird-lime, which has been attended with considerable success in the Portuguese island of Principe.

The remedial measure most generally suggested is to cut off the food supply of the insects by killing all the larger mammals. But advocates of this course are apt to forget that unless the flies are absolutely dependent for their existence upon these large mammals only, the remedy cannot be really effective. The writer has had occasion recently to examine a number of reports bearing upon this question, and the statements made are often highly conflicting; but still,

there appears to be some trustworthy evidence that tsetse-flies, including even *G. morsitans*, can exist in numbers where big game is negligible as a food supply.

These wider questions are beyond the scope of Mr. Austen's handbook, which, however, contains a store of information which will be invaluable to those who are seeking to free Africa from the tyranny of these dangerous pests. G. A. K. M.

THE PSYCHOLOGIST AND THE TEACHER.

The Psychology of Education. By Prof. J. Welton. Pp. xxi+507. (London: Macmillan and Co., Ltd., 1911.) Price 7*s.* 6*d.* net.

WHATEVER criticism Prof. Welton's book may excite, it is undeniably interesting—the most interesting book dealing with its particular problems that has been produced in recent years. With great ability and clearness, the author has drawn a map of life, not as the adult lives it, but as it develops in form and complexity from infancy to manhood. The teacher and the situations with which he deals are in his mind all through. His book is therefore not a treatise on psychology, yet the psychologist's point of view is so dominant that neither does it set forth a theory of education. This Prof. Welton makes clear in his preface. His concern is with the connections between the two—psychology and education—and especially to give a psychological explanation of educational procedure.

The book will surely make a very strong appeal to experienced teachers, for its style is attractive and conspicuously free from abstruse technicalities of expression. Indeed, one is tempted to think that the author has been over-anxious to conciliate the teacher. His opening chapter is particularly addressed to the practical man, who will not fail to note that the psychology which "alone is of worth to the educator" is that "which comes from constant and sympathetic intercourse with children." Although careful reading makes it clear that Prof. Welton means less than he seems to say, it is a mistake, we think, even to seem to imply that all good teachers are willy-nilly good psychologists. There is a distinction between psychological knowledge and a practical acquaintance with psychical relations which comes from experience. The child who uses a brick differently from a ball is not a physicist, nor does social tact constitute a claim to knowledge of psychology. "Every true educator is always making use of real psychology." Is then every true farmer always making use of real chemistry?

The restrictions which the author laid upon himself have led to some difficulties. He very rightly protests against the implicit view of so many child psychologists that children are different from men by reason of their incompleteness.

"Progress is not from a mutilated and incomplete mind to one which possesses all its organs. At every stage of his development, a child's experience is as full and satisfying to him as is that of a philosophical psychologist to himself."

Instead of the serial appearance of new powers to determine the order of which is the main task of the genetic psychologist, his aim should be to show how such development is brought about. All this is admirably put, and as admirably describes the author's object.

In his effort to avoid technical language, however, Prof. Welton has not always been able to achieve satisfying analyses of the processes he describes. In his discussion of the nature of imitation, he restricts the use of the word to what most psychologists call deliberate imitation. This is, of course, giving the word a technical sense, for we call monkeys imitative, though we may deny their intention to imitate. It is no doubt to the writings of M. Tarde that Prof. Welton's protest is due. M. Tarde would find an element of imitation in all that we do, and a term which includes so much tends to obscure rather than to clarify thought. Our author has a second objection to the current use of the word in psychology. To call an action imitative when there is no intention to imitate is to describe its external rather than its psychical attributes. There is a certain justification for this criticism, but it is doubtful whether Prof. Welton's way out of the difficulty helps very much. He would avoid confusion by including all the non-volitional forms of imitation under the term assimilation—the general tendency of man to assimilate his mental life to that of his fellows. But how does such a term suit a case like that of Preyer's tiny infant who pursed his lips as he watched his father doing so? Surely this is distinguishable in analysis from catching the enthusiasm of a crowd.

These all-embracing words—assimilation, apperception, &c.—are a great difficulty in teaching psychology, and for that reason a precise technical terminology cannot be dispensed with. It is as necessary in this subject as in botany, if it is to justify its claim to rank as a science. The whole chapter on the nature of experience is the least convincing in a book which is otherwise extremely readable, and sane to the point of conservatism. No teacher can fail to find much that is helpful in its pages, though he must not expect to get from it an introduction to the methods and results of recent pedagogical inquiry. This Prof. Welton has deliberately left out, except for a gentle gibe at those who use chronoscopes, ergographs, and other terrible machines.

The book is admirably printed, and altogether a valuable addition to English educational literature.

J. A. Green.

TIMBER AND PAPER.

Wood Pulp and its Uses. By C. F. Cross, E. J. Bevan, and R. W. Sindall. With the collaboration of W. N. Bacon. Pp. xi+270. (London: Constable and Co., Ltd., 1911.) Price 6*s.* net.

"THE present is a Cellulose Age," remark the authors of the book before us. Their statement is not made *ad captandum*: it will, they urge, survive critical examination.

Perhaps in their epigram there is just a tinge of the spirit which makes every mother's goose a swan; but be that as it may, there is no doubt that cellulose plays a very important part in modern life. In the

clothing of men's bodies, as in the nurture of their minds, the difference between our own times and those of, say, the Stone age is obviously enormous; and—though this may be less obvious—the difference largely depends upon cellulose. For, not to mention high explosives and celluloid articles, if paper and papyrus, if cotton, flax, and similar textile materials are taken from us, we are back in the days of potsherd writing-tablets, woad, and fig-leaves—back, in fact, to an early stage of civilisation.

Typically cellulose is the purified fibre substance of cotton. Wood-pulp is a special combination of cellulose. In the fibres of wood, the cellulose is associated with substances which have the essential chemical characters of the di-ketones, and hence are designated "lignones." These are chemically much more reactive than the cellulose. Lignones, for example, are very susceptible to oxidation, even by the oxygen of the air, in this respect differing notably from cellulose. Hence paper such as modern "news" paper, which contains ligno-celluloses from wood-pulp as a constituent, on exposure to air and light becomes readily discoloured, and loses its tenacity. The ligno-celluloses are the essential fibrous components of "mechanical" pulp, which is merely wood disintegrated into its constituent fibres by grinding. On the other hand, since lignone is attacked by chlorine, by alkalis, and by alkali bisulphites, it can be separated with these reagents more or less readily from the cellulose with which it is associated, leaving the latter substance in a tolerably pure condition. This product is "chemical" wood-pulp ("soda" or "sulphite" pulp); it differs materially from, and is superior to, the fibre obtained by the mechanical process. Common "news" paper contains about 80 to 90 per cent. of mechanical wood-fibre, and 10 to 20 per cent. of wood-fibre which has been treated chemically; in high-class "news" paper these proportions are reversed. Naturally, "mechanical" wood-pulp is excluded from paper intended for permanent documents. It serves a useful purpose, however, in enabling the demand for cheap publications to be met.

Since cellulose in a more or less pure form can be separated from wood as "chemical" wood-pulp, the question naturally arises whether such pulp cannot be used as a source of cellulose for the production of textile fabrics, high explosives, and celluloid articles. Its relatively low price would seem to give it a considerable advantage. In fact, some success has been met with in respect of the first-named group; for example, in the manufacture of wood-pulp yarn ("silvalin") and of artificial silk (from "viscose"). But the shortness of the fibres is a serious limitation to the use of wood-celluloses for textile purposes. As regards the other groups, wood-cellulose when nitrated has been found to be less stable than cotton-cellulose nitrated to the same degree, and is therefore less suitable for these industrial uses.

The chief woods employed for the manufacture of "sulphite" and "mechanical" pulps are spruce, fir, and pine. For the production of "soda" pulp, aspen, conifers, poplar, and other deciduous trees are utilised; whilst hemlock wood is much used in the making of wrappers and "fibre" papers. After two introductory chapters, the authors discuss the sources of supply of such woods, and then proceed to describe the various operations involved in the manufacture of the several kinds of pulp. The rest of the book deals chiefly with the conversion of the pulp into paper and cardboard, and with its relation to the textile industries.

Professedly the work is written for the general reader, but there is much in it that would be appreciated by the young chemist beginning to specialise in cellulose products. Occasionally the style is heavy and not too clear; but the volume as a whole gives a good general idea of the wood-pulp industry, and the authors' names are a guarantee of its trustworthiness.

C. SIMMONDS.

DR LUNGE AND THE LEBLANC PROCESS OF ALKALI MANUFACTURE.

The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches: a Theoretical and Practical Treatise. By Prof. G. Lunge. Third edition. Vol. iii., Ammonia-Soda, Various Processes of Alkali-making, and the Chlorine Industry. Pp. xix+764. (London: Gurney and Jackson, 1911.) Price 30s. net.

THESE handsome volumes, which we owe to the tireless industry of the emeritus professor of technical chemistry in the Federal Polytechnicum of Zürich, bring the history of the development of alkali manufacture and of its associated industries down to its latest phase. During the dozen or more years which have elapsed since the appearance of the last edition of Dr. Lunge's monumental work, considerable changes have occurred in this department of chemical technology which bid fair, in the fulness of time, completely to revolutionise its methods. A significant feature of modern manufacturing industry is the ever-growing application of electrical energy to its processes, and in no field of production has this application been more fruitful in consequences than in that of industrial chemistry. Although there is, even now, scarcely a single section of applied chemistry which has not felt the influence, directly or indirectly, of this form of energy, it is almost a truism to assert that we are only at the threshold of the new departure.

Dr. Lunge's books bring the story as far as the parting of the ways. He is the faithful chronicler of contemporary achievements, the historian *temporis acti*. He is concerned mainly in giving as full and as accurate a picture of the state of alkali manufacture at the end of the first decade of the twentieth century as is possible to him. As a faithful reflex of the present state of this manufacture the volumes before us suffer from the limitation that they deal only with what have grown to be subordinate processes—that is, processes which are dependent upon the conversion of common salt into alkali through the instrumentality of oil of vitriol, or, in other words, the Leblanc method of manufacture and its associated industries. The supremacy of this method has long since passed away by reason of the elaboration and development of the ammonia-

soda process of Dyar and Hemming. The Leblanc process lives mainly on account of the commercial value of its by-products, but its continued existence even from this cause is seriously threatened by the rapid extension of the methods of producing electrolytic chlorine. Dr. Lunge, no doubt, has it in contemplation to complete his picture by the republication, revised and enlarged, of the third volume of the former edition of his work, in which he dealt with what was then publicly known of the methods of carrying out the ammonia-soda process, as developed by the Solvays, their coadjutors and successors. The appearance of this volume will be awaited with great interest.

In its essential features this edition differs in no material particular from its predecessors. The plan of the original work is substantially unchanged. During a large portion of his long career as a technologist, Dr. Lunge was intimately associated with the practical conduct of the Leblanc process—a process which was nowhere more successfully worked than in England, which constituted, indeed, the chief of our chemical industries, and brought in the aggregate great wealth to those concerned in it. The quondam head of the chemical department of the famous school of technology at Zürich long ago constituted himself the historian of this time-honoured process, which, whatever the future may have in store for it, will always be accounted as one of the most considerable and important of the manufacturing methods of which chemical technology has any record. It occasionally happens that threatened processes, like threatened men, live long. We may express the hope, then, that the days of the Leblanc process are not numbered, and that Dr. Lunge may still long be with us to note and chronicle the changes which may come over it.

GEOMETRY AND ALGEBRA.

(1) *A New Geometry.* By W. M. Baker and A. A. Bourne. Pp. xxii+246+vi. (London: G. Bell and Sons, Ltd., 1911.) Price 2s. 6d.

(2) *Algebra. Part II., for the Use of Students preparing for the Intermediate and Previous Examinations of Indian Universities.* By Prof. K. P. Chottoraj. Pp. iv+486. (Simla, Calcutta: A. K. Chottoraj, 1910.) Price 1.12 rupees.

(3) *Parametric Coefficients in the Differential Geometry of Curves.* By Dr. S. Mukhopadhyaya. Pp. 31. (Calcutta: The University, 1910.)

(1) THIS text-book is an abbreviated and condensed form of the well-known work by the same authors published eight years ago, and therefore requires little comment. The suggestion made in the Board of Education circular on the teaching of geometry that propositions should so far as possible be taken in groups has been adopted. Thus theorems on parallels form the first, properties of a single triangle the second, tests for congruence the third, and constructions the concluding section of book i. The authors have throughout included considerably more material than is required by the Cambridge schedule, particularly in reference to proportion and areas. The last fifty pages of the book are devoted to solid geometry. The properties of line and planes are treated in a fashion very similar to Euclid XI.; this is followed by a number of properties of the tetrahedron, pyramid, cylinder, cone, and sphere. An excellent collection of examples on the mensuration of solid figures is included.

(2) The subject-matter of this volume ranges from quadratic equations to the exponential and logarithmic series, and in doing so covers more than four hundred closely printed pages. It is therefore evident that the treatment is very thorough. There is indeed far too much detail; all sorts of special and artificial cases are dealt with, apparently in order to fortify the student against every possible difficulty he may be likely to encounter. For those whose sole object is to pass examinations this may be advantageous, but on general grounds it is highly undesirable. The author has a lucid style, and has evidently arranged both the text and the examples with the greatest care. His book should be most useful to the teacher, but we are inclined to think it will be rather oppressive for the student.

(3) This pamphlet is the result of a series of investigations the author has made in differential geometry. The method of parametric coefficients was evolved from an attempt to obtain by elementary means expressions for the radius of curvature and aberrancy in terms of the arc. The first part of the paper deals with the properties of parametric coefficients of n-dimensions, and then applications are made to plane curves; these include the deduction of the equation of the osculating cubic and the general differential equation of the cubic. It is stated that additional applications will be found in a further paper by the author which will be published shortly.

MECHANICS AND TESTING OF MATERIALS.

(1) *Elements of Mechanics, with Numerous Examples for the Use of Schools and Colleges.* By G. W. Parker. Pp. ix+245. (London: Longmans, Green, and Co., 1911.) Price 4s. 6d.

(2) *A Handbook of Testing.* By Prof. C. A. M. Smith. Materials. Pp. xii+284. (London: Constable and Co., Ltd., 1911.) Price 6s. net.

(1) THIS book is intended for the use of students having only a comparatively elementary knowledge of mathematics; great care has been taken to ensure that the student should acquire thoroughly clear ideas of the first principles which form the groundwork of the subject, and this has been borne in mind in working out the numerical examples illustrating the various laws. The first part of the book is devoted to statics, the branch of the subject of perhaps the greatest importance to the engineer; composition and resolution of forces in one plane, moments of forces, parallel forces, couples and their composition, centres of gravity, and conditions of equilibrium are successively dealt with, and then the application of the laws, which have been deduced, to

the case of the so-called simple machines, all of them considered as frictionless, is taken up.

The last chapter of this section is devoted to an elementary treatment of the laws of friction, the rough inclined plane being used as an illustration. As a frictionless machine is a mere mathematical fiction, adopted probably with the idea of smoothing the path of the student, it is a pity that the author did not in the chapter on friction take one of the simple machines, say the screw, and show how materially such a formula as that deduced in the previous chapter for the relation of power to weight is modified directly friction is taken into account, and the problem changed from a mere exercise in applied mathematics to the practical question a young engineer is constantly called upon to face. It is doubtful if it is beneficial to students to set them to work out problems on frictionless machines.

In part ii. dynamics is taken up—velocity and acceleration; the laws of motion and their application to motion on rough planes, Attwood's machine, &c.; composition of velocities and accelerations are fully discussed. The last three chapters treat of uniform motion in a circle, work, and simple harmonic motion.

The author is to be congratulated on the excellent series of examples given at the end of each chapter.

(2) Laboratory work on the testing of materials forms an important part of the training given in engineering colleges at the present day, and many teachers and students have felt the need of a good text-book on the subject. Mr. Smith has done excellent research work on the effect of combined stress, and has devised ingenious strain-measuring apparatus for use in his researches, and he is now to be congratulated on having written a book which will be welcomed by all those who are engaged in the branch of experimental work known as the testing of materials, whether they are students just beginning to feel that they are entering upon a new field of fascinating work, practical men engaged in the daily task of commercial tests, or advanced students busy with research work upon one or other of the difficult problems which still require elucidation. The book is well illustrated, and the illustrations are so drawn that they show the essential principles of the machine or apparatus, a matter of great importance to the student who wishes to design similar appliances in connection with his own experimental work; the chapters on strain-measuring instruments and on alternating stress tests deserve special praise in this respect.

In the last chapter the author has given valuable advice and suggestions as to the best lines on which experimental work can be carried out in college laboratories, and a table of suitable experiments with notes as to the necessary apparatus. The book concludes with four appendixes, a bibliography, and a table of constants; the third appendix is devoted to a discussion on all the recent researches on combined stress, including the author's own work, and forms one of the best summaries which have yet appeared of the present state of knowledge on this important question.

T. H. B.

OUR BOOK SHELF.

General Index to the Monthly Notices of the Royal Astronomical Society, volumes liii. to lxx., 1892–1910, together with the General Index to Illustrations in the Memoirs, volumes i. to lix., and the Monthly Notices, volumes i. to lxx., 1822–1910; appendix, List of Comets, 1892–1910. Pp. viii+198. (London: Royal Astronomical Society, 1911.) Price 5s.

THIS index is one of fundamental importance to all workers in astronomy, and is a sequel to those previously published for vols. i. to xxix. and vols. xxx. to lii. respectively; it is hoped in future to publish general indices covering successive even periods of twenty years. The arrangement of the present volume from the annual indices prepared by Mr. Wesley has been carried out by Mr. Levander, under the general direction of the secretaries, and he is to be congratulated on the success attained.

Many of the headings have, by reason of the progress in astronomical work during the past twenty years, had to be rearranged or modified, and the changes are carefully explained in the preface. The present section dealing with the "Monthly Notices" takes up 168 pages, with something like forty references on each page, a tribute to the energy displayed by the authors of papers as well as to the completeness of the index.

Mr. Knobel has prepared the index to the illustrations, and this should prove exceedingly useful, as the items are arranged under subject headings, *e.g.* moon, planets, instruments, &c., the authors' names being given in approximately the chronological order of the papers.

Dr. Crommelin's appendix gives particulars of all the comets observed during the period 1892–1910, commencing with an apparition of Barnard's periodical comet in 1892, and ending with Brooks's second periodical comet 1910*d*. In view of the plenitude of comets during the present year it is interesting to note that the average number per annum, for 1893–1910 inclusive, works out at 4·7, the greatest number being 10 in 1898.

Many copies of the previous general indices remain in stock, and will be presented to such institutions and observatories as receive the "Monthly Notices," but have not the indices; application should be addressed to the assistant secretary.

Evolution, Life, and Religion: a Study. By the Rev. E. B. Kirk. Pp. 321. (Glasgow: John Smith and Son, Ltd.; London: James Clarke and Co., n.d.) Price 5s. net.

THE author of this book states his personal interpretation of cosmic and human evolution, which he considers from a philosophical and theological point of view. There has been material and spiritual progress from the simplest forms towards those of ever-increasing complexity, and the author interprets this as a continued expression of the Logos. He illustrates this by a fundamental diagram which he calls the "Logos-mirror." He has hold of the sound idea that scientific and intuitive interpretations must be regarded as complementary, not as antithetic, but his own personal equation bulks so large that it is difficult for the reader to get alongside of him. As it seems to us, Mr. Kirk intermingles different "universes of discourse" in a manner which is always unprofitable, as when he seeks to show that various fundamental doctrines of theology are expressions of fundamental laws of nature.

We have great sympathy with the proposition that "the mental continuity of creation in our world is as marked as the physical, and the lower

creatures are one family with the higher throughout," but we do not follow the author's theory of "spiritual inheritance" as opposed to "physical inheritance." Perhaps the right of making pronouncements regarding the scope of physical inheritance in garnering the past has not been earned by an author who tells us that "the human bowel is a worm." We do not mean, however, that this quaint sentence is in any way essential to the author's argument.

The Wanderings of Peoples. By Dr. A. C. Haddon, F.R.S. Pp. vii+12+5 maps. (Cambridge University Press, 1911.) Price 1s. net.

IN this little volume, one of the handy manuals issued by the Cambridge University Press, Dr. Haddon deals with the movements of the world's population from those times "when mortals knew no shores beyond their own" down to the modern movements in quest of political, social, or religious freedom.

The introduction deals with the general factors which determine the impulse and direction of migrations. The author also summarises the evidences for racial or cultural drift which are to be found in the physical characters of peoples, and in their artifacts, customs, folklore, and speech.

The main body of the work is a marvel of condensation. Into little more than one hundred pages Dr. Haddon has contrived to pack in terse and vivid phrases a whole history of the world so far as that history is correlative with ethnology and geography. Asiatic migrations and their sequence in Oceania are described in one chapter. Europe and Africa have each a chapter to themselves. The American peoples —North, Central and South—require for the history of their wanderings a space equal to two-thirds of that of the rest of the world together. One value of the book consists in the fact of its being an index to a more detailed examination of its subject. Each chapter is accompanied by its bibliography, and each paragraph is referred to its authority. For reference purposes the book is thoroughly up to date, and works appear in the bibliography which have appeared since its own chapters were in print. The five maps, owing to their small size, only show the more important migrations, but nevertheless they give a good general idea of the movements which have taken place on each continent. S. H. R.

The King to His People: Being the Speeches and Messages of his Majesty George V. as Prince and Sovereign. Pp. xviii+452. (London: Williams and Norgate, 1911.) Price 5s. net.

ONE of the most impressive characteristics of these speeches and messages is the remarkable manner in which the British Royal Family has been able to sympathise with, and be interested in, every aspect of the lives and enterprises of British subjects in all parts of the Empire. Whether addressing the Royal Society, speaking to school children, presiding at philanthropic meetings, officiating at military and other functions, his Majesty has shown a genius for speaking the right words at the opportune moment. The messages, "Wake up, England!" "Have Courage, Be Thorough," "The Rule of Science," and others, have served as an inspiration to workers throughout the Empire.

Probleme der Protistenkunde. By Prof. F. Doflein. II., Die Natur der Spirochaeten. Pp. vi+36. (Jena: G. Fischer, 1911.) Price 1.20 marks.

THE first of Prof. Doflein's studies, that on the Trypanosomata, was noticed in NATURE of June 24, 1909, p. 489. The present work deals with the Spirochaetæ, spirillar micro-organisms met with in ditch water and also in connection with many diseases, such as the relapsing fevers and syphilis, and as commensal parasites in the fresh-water mussel, &c. Some are doubtless vegetable in nature, but many must probably be regarded as belonging to the protozoa. From a critical survey of the minute structure of several species the author divides the spirochaetes into three groups: (1) Spirochaeta, with a central staining filament; (2) Cristispira, with a marginal staining filament; and (3) spirochaetes with a flattened band or lamella. He does not consider that sexually differentiated individuals have been proved to occur. The pathogenic forms, like many trypanosomes, are transmitted by blood-sucking arthropods, principally ticks. The essay is illustrated with many figures, and is a useful contribution to this important subject. R. T. H.

Arbeiten aus dem Gebiet der experimentellen Physiologie. Edited by Dr. Hans Friedenthal. Teil ii., 1909–10. Pp. viii+286+5 plates. (Jena: Gustav Fischer, 1911.) Price 5 marks.

THIS is a collection of twenty-seven papers which have previously been published in various German journals, or in the proceedings of scientific bodies. They have been carried out in Dr. Hans Friedenthal's private laboratory near Berlin, by Dr. Friedenthal himself and his colleagues. They represent a large amount of fruitful and painstaking labour, and relate to a great variety of subjects. The publication of collected papers from individual laboratories is often a great convenience to other workers, and Dr. Friedenthal is to be congratulated on his valuable output of the last few years. W. D. H.

The Process of the Year. Notes on the Succession of Plant and Animal Life. By H. H. Brown. Pp. 180. (London: Society for Promoting Christian Knowledge, 1911.) Price 2s. 6d.

THOUGH it does not appear to be his primary object, Mr. Brown has condensed much useful reading on nature-study into his volume. His "leading purpose is to show that the world is beautiful and happy." The year is divided into seven periods corresponding with the seven ages of man, and in each division a series of typical plants and animals is considered.

Philosophy. By Nicholas Murray Butler, president of Columbia University. Pp. vii+51 (London: Henry Frowde, 1911.) Price 4s. 6d. net.

THE third thousand has now been issued of President Butler's lecture, delivered on March 4, 1908, in the series on science, philosophy, and art, at Columbia University. The purpose of the lecture was, the preface points out, clearly to differentiate philosophy from science and "to cut away the odd and unfitting scientific garments in which some contemporary writers have sought to clothe philosophy."

Bergson. By Joseph Solomon. Pp. 128. (Philosophies Ancient and Modern.) (London: Constable and Co., Ltd., 1911.) Price 1s. net.

THE series to which this little volume has been added already included sketches of some fourteen systems of philosophy, but none of them formulated by a contemporary thinker. M. Bergson has been so much in the public eye recently that many readers will be glad to acquaint themselves with the teaching of this twentieth-century philosopher.

Confessions of a Robin. By Lieut.-Colonel A. F. Mockler-Ferryman. Pp. 192. (London: Society for Promoting Christian Knowledge, n.d.) Price 2s.

THIS story of incidents in the life of a robin will appeal to young children, who will not regard talking robins, with a well-developed power of consecutive thought, as incongruous. The tale reveals the author as a sympathetic observer of bird-life.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Relation of Big Game to Sleeping Sickness.

THE article by Sir Harry Johnston in NATURE of December 7 on "The Preservation of the African Fauna and its Relation to Tropical Diseases" gives a most admirable and sympathetic review of the subject; but there is one statement to which I must venture to take exception as not conveying, in my opinion, an accurate impression of the known facts of the case, namely, the following sentence:—"But within the last twelve months or so it has been proved conclusively by the biologists at work in Uganda that the large antelopes of that country are the hosts of dangerous trypanosomes, amongst others of the trypanosome which causes sleeping sickness."

So far as I am aware, this statement is based on the experiments reported by Bruce, Hamerton, and Bateman (Proc. Roy. Soc., B, 83, pp. 311–27), in which it was shown "that antelopes can be readily infected with sleeping sickness by the bites of artificially infected tsetse-flies" (p. 317), and that "the flies (*Glossina palpalis*) when infected by the virus of sleeping sickness obtained from the blood of infected antelopes are capable of transmitting the virus to susceptible animals" (p. 319). These results are based entirely on experiments conducted in the laboratory, and the authors state expressly that "positive evidence" is required "to complete the chain of evidence that antelope living in the fly-areas may act as a reservoir of the virus of sleeping sickness. *So far it has only been proved that they are 'potential' hosts*" (p. 325; the italics are mine).

The only instances known to me in which *Trypanosoma gambiense*, the trypanosome of sleeping sickness, has been identified as occurring in the blood of wild animals, naturally infected, are two in number, and in each case the animal was a monkey, and the locality Uganda; one such case is reported by Koch, Beck and Kleine (*Arbeiten k. Gesundheitsamte*, xxxi., p. 18); the second is reported by Bruce and his collaborators (Sleeping Sickness Reports, xi., p. 102). If there are other known instances of *T. gambiense* occurring naturally in wild animals, I should be glad to be informed of them; if there are not, however, it seems to me premature to state that antelopes have been proved to be the hosts of the trypanosome of sleeping sickness. If laboratory experiments have shown them to be the *potential* hosts of *T. gambiense*, the same can be said of many other animals which can be inoculated with this trypanosome in the laboratory. The following list of animals susceptible to *T. gambiense* is taken from Laveran and Mesnil, "Trypanosomes and Trypanosomiases," p. 382 (translated by Nabarro; Baillière, Tindall and Cox, 1907):—monkey (several species), lemur, dog, jackal, cat, rabbit, guinea-pig, rat, mouse, jerboa, hedgehog, marmot, horse, donkey, cow, goat. and sheep. This list is based chiefly on experiments performed in Europe, using European mammals or exotic animals in captivity, and there is no doubt it could be greatly extended by anyone experimenting systematically in the tropics on tropical animals; but as it stands it is sufficiently extensive, and indicates that a great many species of wild animals, small or large, might be incriminated as potential hosts of *T. gambiense* equally with the antelopes, and that the destruction of the "big game" alone would be likely to produce very little amelioration, if any, in the conditions.

The whole history of sleeping sickness in Uganda indicates that the disease has been imported from the west by human agency (compare Laveran and Mesnil, *op. cit.*, pp. 359–66), and that man is the primary host of the trypanosome, at least in Uganda. If, however, the parasite has now been transmitted from man to other susceptible animals by the tsetse-flies, there is no reason to repard the antelopes or other big game as having monopolised the functions of being "reservoir" hosts of the virus. From the point of view of preventing the infection from spreading from animals to man, domestic animals would seem to be a much greater danger as a reservoir of the virus than antelopes and creatures the natural instincts of which impel them to keep at a distance from the haunts of human beings.

If, therefore, it is desired to extirpate the potential hosts of *T. gambiense* in regions where sleeping sickness is rife, it would not be sufficient to destroy the big game; it would be necessary to convert the whole country into an uninhabited and lifeless desert. In my humble opinion this method of preventing the spread of sleeping sickness is a futile one, and not likely to yield useful results. I believe that there is only one practicable method of interrupting the transmission of the trypanosome, and that is by measures calculated to destroy or keep down the tsetse-flies. At the present time the most urgent need is more knowledge of the bionomics of the species of Glossina and of their natural enemies. Some years ago I made the suggestion in NATURE (November 8, 1906) that fowls, wild or domesticated, would be likely to be efficient in keeping down the flies by scratching up their pupæ and eating them, but, so far as I am aware, no experiments have ever been carried out to put this notion to the test. So long as sleeping sickness cannot be made amenable to treatment, attention must be concentrated on prevention, the central problem of which, in my opinion, is the destruction of the insects concerned in the transmission of the disease.

E. A. MINCHIN.

Lister Institute of Preventive Medicine, Chelsea Gardens, S.W., December 9.

The Inheritance of Mental Characters.

THE reply of Dr. C. Walker to Dr. Archdall Reid in your issue of last week seems to me somewhat quibbling, and suggests that he is not intimately acquainted with Prof. Pearson's Huxley lecture. The particular part of this lecture quoted by Dr. Reid, and referred to by Dr. Walker, reads actually as follows, the italics being Prof. Pearson's own:—". . . We have found the *same* degree of resemblance between physical and psychical characters. That *sameness* surely involves something additional. *It involves a like heritage from parents.* The degree of resemblance between children and parents for the physical characters in man may be applied to the degree of resemblance between children and parents for psychical characters. We inherit our parents' tempers, our parents' conscientiousness" (not *consciousness*, as printed in Dr. Reid's quotation), "shyness, and ability, even as we inherit their stature, fore-arm, and span."

Now surely Dr. Walker cannot justly charge Dr. Reid with misinterpreting Prof. Pearson's statement in this instance, where Dr. Reid apparently infers from the words "*a like heritage*" that Prof. Pearson meant "*inherited in the same way*"; and that the words "*a like heritage*" implicitly connote in this context an actual identity of the modes of *transmission* and *reproduction* of a parent's "conscientiousness" with those of the transmission and reproduction of a parent's fore-arm. Nor, it seems, would it be unfair to impute, on this ground, to Prof. Pearson the doctrine that external influences brought to bear on the child, such as experience of the world, training, example, &c., could not have any greater effect on his ultimate "conscientiousness" than any external influences could exert on the ultimate length of his fore-arm.

London, December 10. H. BRYAN DONKIN.

I THINK Dr. Walker is scarcely clear as to the situation. A personal acquaintance with a writer is not necessary when we judge his published opinions. By "character" biologists mean any trait of a living being—a head, a hair, a characteristic of a hair, a characteristic of that characteristic, and so on. Of course, no character of any sort—neither a head nor a scar, for example—can develop in the individual unless the potentiality to develop it under fit conditions is antecedently present. If, then, we think in terms of germinal potentiality, all characters, for example heads and scars, are equally inheritable. But biologists commonly apply the term "acquired" to actual somatic characters which have developed under the influence of use or injury, the term "inborn" to characters which

developed in the absence of these influences, and the term "inheritable" to characters which were present in the parent and tend to be "inborn" in the offspring. Thus they speak of heads as inborn and inheritable, and of use-callosities and scars as acquired and non-inheritable. I am not concerned here with the correctness of these terms. My statement of the manner in which they are used is correct.

Prof. Karl Pearson employs the term "inherit," but not, to my knowledge, the terms "inborn" and "acquired." Instead, he uses "bred" and "created," which apparently are intended to mean the same. He has not, I believe, defined any of his terms Presumably, therefore, he uses them with their ordinary meanings. If he does not, then not only have I been mistaken, but also almost everyone else, including such a careful thinker as Sir Ray Lankester. In that case, what is the meaning of the expression "bred, *not* created"? Is potentiality meant here? The italics are mine.

Even in the absence of statistical inquiry, it is a common conviction that individuals tend to resemble their progenitors mentally as well as physically. Thus the offspring of a vertebrate is another vertebrate, of a man another man, of a Hottentot another Hottentot, and so on. But individual characters are less certainly inherited than varietal characters, varietal characters than specific characters, and so on. Prof. Pearson's work concerns only individual characters (*i.e.* variations); but he makes—not once but repeatedly, not only in scientific memoirs but also in popular lectures and letters to newspapers—the *unqualified* statement that the mental and physical characters of man are inherited at the same rate. It seems that this rate is "somewhere about 0·46 to 0·50." His estimate, if it led nowhere, would have no more importance than, for example, a calculation concerning the average length of noses. But it leads him somewhere—to the notion that the moral and intellectual qualities are "bred, *not* created," instead of to the notion that they are bred *and* created. It leads him to a false opposition between "nature" and "nurture," instead of to the really quite obvious truth that the nature of man, the educable animal, is such that he is supremely responsive to nurture. It leads him to the notion that the poorer classes in England are, on the average, by nature inferior to their more fortunate compatriots, and thence to dire predictions concerning our future as a nation and to demands that something shall be done. It would lead him, I suppose, to the notion that an English baby, reared by African cannibals, would, when grown, resemble his progenitors and differ from his educators as much mentally as physically. And so on and so forth. No one, I suppose, disputes that individuals vary in capacity. The dispute, in the case of the moral and intellectual traits, is entirely as to whether capacity can become more than mere potentiality unless nurture plays its part as the other blade of the scissors. In other words, the dispute is as to whether these traits are or are not acquirements, that is, products of man's educability *plus* his individual experience.

The biometric plan of ascertaining correlations between variations, and thence surmising a causal connection, is not, as is commonly supposed, a new instrument in the hands of men of science. It is merely a variant of the very old method of concomitant variations which is described in almost every book on logic and in almost every work on the methods of science. There is, however, this difference: according to the method of correlated variations as exemplified by biometricians, if two things vary together *on the average*, there is *invariably* a causal connection between them; according to the method of concomitant variations as described by logicians, if two things *invariably* vary together, there is *probably* a causal connection.

In my letter I stated that Dr. Walker had reproduced some of my opinions in his book almost in my own words. I should have added that he made very full acknowledgment.

G. ARCHDALL REID.

Southsea, December 10.

IN Dr. C. Walker's quotations (NATURE, November 23 and December 7) from Dr. A. Reid's paper, Prof. Karl Pearson is represented as saying: "We inherit our parents' tempers, our parents' consciousness," &c.; this should read: "We inherit our parents' tempers, our parents' *conscientiousness*," &c. (see Journal Royal Anth. Inst., vol. xxxiii., p. 204).

E. LAWRENCE.

"Kama," Sunningdale Avenue, Westcliff-on-Sea, December 11.

Temperature of the Upper Atmosphere.

MESSRS. GOLD AND HARWOOD in their paper on the present state of our knowledge of the upper atmosphere, printed in the British Association's reports for 1909, give a table showing the mean temperatures for the months of the year at heights varying from the surface to 15 kilometres. With regard to it they say the principal feature is the very marked minimum in March and the small, though less marked, effect in September. The table is based upon about 5800 readings taken at Strassburg during five years. With the aid of this table I have plotted on the accompanying diagram the temperatures at various

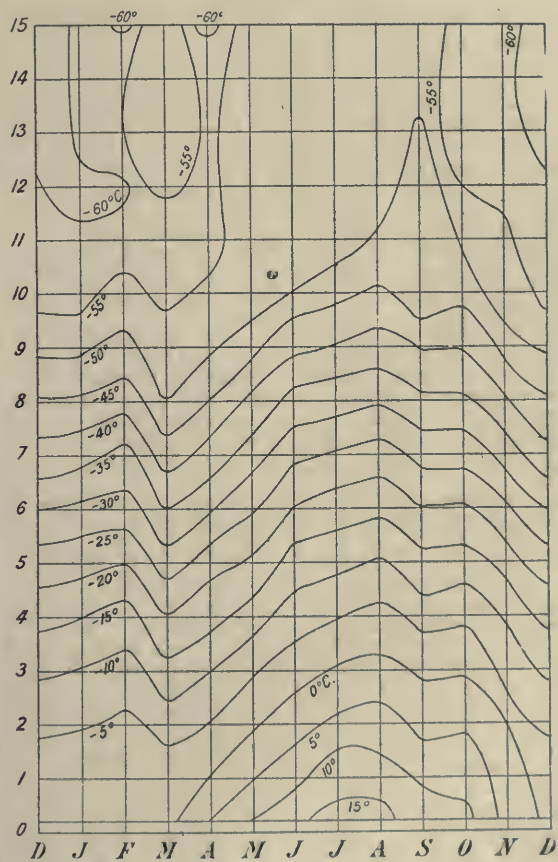


FIG. 1.—Temperature variations throughout the year at different heights.

heights (isotherms). Plotted in this manner, a result is obtained which shows clearly that a check in the fall of temperature takes place between September and October. The principal feature, however, is the rise of temperature between December and February, and the small gradient of temperature below 2000 metres during those months.

The tracing of the isotherms in the advective layer presents some difficulties, owing to the abnormal conditions prevailing in it. It would appear that during December a low temperature condition prevails, and appears to die away from the top downwards, disappearing at a height of about 12,000 metres in February. In March there is a marked inversion of temperature between 12,000 and 15,000 metres which does not seem to continue into April.

Between April and May, however, the isotherm of $-55°$ passes into the upper atmosphere, where, comparatively speaking, warm conditions prevail in the advective layer from May to September. As this method of plotting the results shows clearly the temperature variations throughout the year at high levels, I thought the diagram might be interesting to your readers. R. M. DEELEY.

Inglewood, Longcroft Avenue, Harpenden.

The Weather of 1911 and the Ultra-violet Radiations of the Sun.

IN connection with Dr. Shaw's attempt to explain the remarkable weather of this summer (NATURE, November 30), I should like to direct attention to a point of view which in general, but especially in the past summer, deserves the attention of meteorologists. My remarks are based on a series of experiments which I carried out, together with Prof. Lenard (P. Lenard and C. Ramsauer, "Über die Wirkung sehr kurzwelligen ultraviolleten Lichtes auf Gase und eine sehr reiche Quelle dieses Lichtes," Heidelberger Akademie, five parts, 1910–11).

Dr. Shaw states that all conditions necessary for a heavy rainfall appeared to be present, without rain falling. But he has not paid attention to an important condition: for the production of rain nuclei must be present, which can serve as centres of condensation when all other necessary conditions are fulfilled. The absence of such nuclei is in my opinion the chief cause of the remarkable weather of this year.

In the work just quoted we have clearly separated, for the first time, the different actions of ultra-violet light on gases, and explained the complicated effects due to their simultaneous existence. We distinguish three actions of ultra-violet light on dust-free gases:—

(1) The formation of electrical carriers of molecular size, caused by selective absorption of the light; the power which these carriers possess of producing condensation is, according to our experiments, very small compared to that of the nuclei, originally neutral, mentioned under (3).

(2) Chemical action, *e.g.* formation of ozone in oxygen; this effect is connected with but small absorption of the light.

(3) Formation of condensation nuclei, *i.e.* formation of solid or liquid products by the direct action of the light on the gases; *e.g.* formation of drops of hydrogen peroxide from water vapour, as found by Mr. C. T. R. Wilson, or by subsequent reaction of the products formed with the other components of the air, *e.g.* formation of ammonium nitrate and nitrite from ozone and ammonia. The size of these nuclei depends on the intensity of the light and their time of formation. Their chief property is their great power of acting as centres of condensation, and the larger they are the more active in this respect. They possess *originally* no electric charge, but easily acquire one if carriers of electricity are simultaneously produced by coming together with these; the presence of a charge has no effect on their power of acting as condensation nuclei.

This gives us the chief source of nuclei in the earth's atmosphere. If we neglect the purely local formation of nuclei in large centres of industry, then the ultra-violet, and to a minor degree the kathode, radiation of the sun is chiefly responsible for the nuclei which are meteorologically so important. This production of nuclei extends from the uppermost down to fairly low-lying layers of the air, as the active rays are only absorbed to a small extent, and is chiefly conditioned by the amount of oxygen and ammonia present.

Thus the lack of nuclei, and the consequent fine weather of this year, can be attributed to a much diminished ultra-violet radiation of the sun. This is in accord with the now existing minimum of general activity of the sun, as characterised by the minimum of sun-spots and northern lights. This view is not contradicted, but confirmed, by the high temperature on the surface of the earth, as this is principally conditioned by the increased clearness, *i.e.* transparency to heat radiations, of the atmosphere.

CARL RAMSAUER.

Radiologisch-Physikalisches Institut, Heidelberg, December 9.

"Draysonia."

IN NATURE of November 16 you have done me the honour of inserting a review of my book "Draysonia." As the reviewer appears to have been under some misapprehension, I beg you will in justice do me the favour of inserting a few words of explanation.

I am well aware of my inability to do full justice to the late General Drayson in attempting to bring his theory under public notice. But it is evident that your reviewer, after perhaps a hasty glance at "Draysonia," has not considered it worthy of close perusal; otherwise he would scarcely have assumed that a naval officer who has had the "Nautical Almanac" in use for more than seventy-one years (and has made nautical astronomy an occupation and recreation) "confuses precession with aberration," and is therefore "scarcely fitted" to deal with the subject.

Your reviewer may possibly be a professional astronomer (who perhaps dislikes anything unorthodox and not in accordance with the text-books), and, if so, he will be aware that in the later "Nautical Almanacs" the word "precession" in the catalogue of stars has been substituted for the old and better term "annual variation," which was used in the "Nautical Almanac" and by our old astronomers for as many years as I can remember up to 1894 or 1895, when the change was made. Previous to this the word precession had been mainly confined to precession of the equinoxes (dealt with in section 6 of "Draysonia"), which at present is about 50″ and is totally distinct from what astronomers term aberration, but which I prefer to call annual motion of the pole.

Your reviewer further states that I have computed the precession of many stars by Drayson's method, and that, if this proves anything, it proves the correctness of the "Nautical Almanac." This is a mistake and is an inversion of my process. Instead of having, as he stated, calculated the so-called precession of many stars, I have used the precessions, so accurately given in the "Nautical Almanac," in order to find therefrom the amount of the annual motion of the pole; and I have shown that the so-called annual precessions of the stars, all varying in amount and direction, both in right ascension and declination, are exactly accounted for by one single movement of the pole of about 20″, which produces the apparent annual precession as obtained by observation and recorded in the "Nautical Almanac," the accuracy of which I have never impugned.

I am unable to understand why your reviewer questions my statement that Mr. Stone, the late Radcliffe observer at Oxford, made the error of sidereal time erroneous to the extent of 41·51s. in 1892. A reference to the Royal Astronomical Society's notes of March, 1894, will show that I am correct. ALGERNON DE HORSEY.

Melcombe House, Cowes, November 19.

I AM quite willing to admit that I have misunderstood the gallant Admiral, and accept unreservedly his statement that he does understand the difference between precession and aberration. In my own defence you will perhaps permit me to quote the passage which misled me.

"Possibly I shall be told that I have found a mare's nest, and that it has been known all along that the right ascension of a star and its annual precession in declination are functions of the annual motion of the pole, and that such motion can be found in the 'Nautical Almanac,' *and is properly termed aberration.*"

The italics are mine. To my mind this sentence admits of only one construction; and, if I have been so unfortunate as to misconstrue it, I have no doubt I have not correctly apprehended the author's meaning in other places, and therefore it is of little use to discuss the several points raised. THE REVIEWER.

Dust Explosions.

PROF. GALLOWAY's brief article on dust explosions in NATURE of November 30 is very timely; but readers of it would receive the impression that the true cause of the explosion at the Tradeston Flour Mills, Glasgow, in 1872, was first made known in the report of Profs. Rankine and Macadam. This is not the case: the fact that flour-mill ex-

plosions are actually dust explosions was first stated in England by Mr. Watson Smith, editor of the Journal of the Society of Chemical Industry, in a letter which appeared in *The Glasgow Herald* on July 12, 1872, immediately after the Tradeston disaster. The priority of Mr. Watson Smith was recognised at the time by the Royal Society of Edinburgh, and later (in 1882) by Sir Frederick Abel in a lecture at the Royal Institution.

It is interesting to know that nearly six years ago Mr. Watson Smith read a paper at Liverpool (the scene of the latest dust explosion) in which stress was laid on the fact that any kind of carbonaceous dust might, under certain conditions, become a source of danger (see Journn. Soc. Chem. Ind., January 31, 1906).

ALBERT SHONK.

10 Dartmouth Road, Hendon, December 5.

I MUCH regret that I had entirely forgotten the fact, stated in Mr. Shonk's letter, that Mr. Watson Smith had attributed the disaster at the Tradeston Flour Mills to an explosion of dust in a letter to *The Glasgow Herald*, published before the report of Profs. Rankine and Macadam appeared, or I would certainly have mentioned it in the article referred to.

W. G.

The Feeding Habits of Crepidula.

WITH reference to the note on Crepidula in NATURE of December 7 (No. 2197, p. 187) it may be of interest to your readers to know that during some recent researches on this animal I have been able to confirm the necessity for investigating how far the presence of the slipper-limpet (*Crepidula fornicata*) is a menace to successful oyster-culture on the Kent and Essex coasts. It has been believed by various naturalists that Crepidula takes the same kind of food as the oyster, but on this point there exists no definite information. During an investigation of this matter I discovered the manner in which the animal feeds, from which there can be no doubt whatever as to the nature of its food. The mode of feeding in Crepidula is the same in principle as that of the oyster, that is, there is an ingoing and an outgoing current of water kept up in the mantle-cavity, while between the two currents the gill acts as a strainer, retaining even very fine particles of suspended matter, which eventually—by one of two ways—reach the mouth.[1]

Thus it is established beyond doubt that Crepidula feeds on the same material as the oyster, that is, on the food-material found on or floating near the sea-bottom, and the danger apprehended from this intruder is confirmed: Crepidula is competing successfully with the oyster for food and space. Whether there is enough food and space for both Crepidula and oysters is another matter which must be determined by local researches. Thus the problems for the Kent and Essex oyster-farmers are to keep up the food supply of oysters and to reduce the numbers of Crepidula and the many other animals which take the same food as oysters.

J. H. ORTON.

Marine Biological Laboratory, Plymouth,
December 10.

[1] It is proposed to publish a full account of how Crepidula feeds in the next number of the Journal of the Marine Biological Association.

Tadpole of Frog.

AT the beginning of April last I collected some frog ova for the purpose of making observations on development. Tadpoles appeared about April 9, and from time to time from that date until July 17, when young frogs were developed, I took batches away for preservation and sectioning. On July 17 only one tadpole was left of the original stock, and that one, though in water out of doors and with a supply of waterweed, has not developed farther, but is a tadople still and is still alive. Some years ago I had a similar case with a frog tadpole. Can any of your readers suggest the reason of this phenomenon?

T. PLOWMAN.

Nystuen, Bycullah Park, Enfield, December 8.

MICROKINEMATOGRAPHY.

WITHIN the last few months we have been shown a new appplication of the kinematograph, which indicates yet another stage of technical attainment, and another field in which it may supplement our knowledge. Its range has been extended to the representation of objects as seen through high powers of the microscope. Apart from any positive increase to knowledge which may be obtained by its means, this is a technical achievement of a very high order. In the usual microscopic preparation it is impossible to obtain a high degree of illumination, and the greater the magnification the less the illumination becomes. It is only by artificially increasing the contrast by means of stains and so forth that we can obtain a clear differentiation of even a motionless object. To take in one minute some thousands of successive photographs of a living, unstained object, magnified six hundred or a thousand times, an object, moreover, which is moving rapidly, and therefore continually altering its focal plane, is a task which might easily seem impossible.

M. Comandon, however, has succeeded in this extremely difficult problem. The illumination-difficulty he avoided by using what is known as the ultra-microscope or dark-ground illumination, in which the object is seen against a black background, being lit itself by rays of light striking it from the side, and thence deflected upwards towards the lens of the microscope. This method gives an extremely brilliant contrast-illumination of the outlines of the object against a black ground and makes it possible to take on a properly sensitised film photographs of exceedingly short exposure. The resulting picture naturally shows comparatively little of the internal structure of the object under examination; the bulk of the rays of light are deflected from its surface. But it is surprising how much does appear. The nucleus of a cell, for example, is frequently quite distinct, and some structures, such as the kineto-nucleus of a trypanosome, can sometimes be seen perfectly clearly and be followed as the organism moves from place to place. A large number of films prepared under the direction of M. Comandon has been exhibited during the present year by Messrs. Pathé Frères, and the realism and vitality of these kinematograph pictures can scarcely be imagined by anyone who has not seen them thrown on the screen.

An interesting film is one which displays the blood actually circulating in the vessels of the living body. The preparation, which is from the tail of the tadpole, shows a number of tiny blood-vessels, which measure about one-hundredth part of a millimetre in diameter. Crowded together in the larger of these, the individual corpuscles of the blood can be seen to pass out one by one into minute branches, for which they seem almost too large, and within which they make their way here and there through the surrounding tissue, not apparently without occasional difficulty. Even in the larger vessels, along which the bulk of the corpuscles are hurrying, the rate of progress varies considerably, and the direction may actually be reversed for a time and the blood apparently flow backwards. The coloured corpuscles of the blood, from which it derives its red tint, have, of course, no independent motion of their own, and are simply carried along by the stream in which they are suspended. But the colourless cells or leucocytes have such independent motion, and in another film we are shown a white cell gradually altering its shape, throwing out a long filament into which the rest of the corpuscle slowly flows, until the whole cell has altered its posi-

tion and moved from one place to another. By aid of this motion these leucocytes are able to fulfil one of their best-known functions, which is to act as

FIG. 1.—Series of pictures of normal human blood. From a kinematograph film.

FIG. 2.—Amœboid movement of leucocytes.

FIG. 3.—Trypanosomes in the blood.

FIG. 4.—Spirillosis of fowls.

FIG. 5.—Relapsing fever.

scavengers of the vascular ways of the body, and to take up into themselves abnormal substances with which they come in contact, whether microbes, diseased cells, or granules of inert matter; and this process is illustrated for us by a series showing the gradual surrounding and ingestion of a red corpuscle by a white cell. This is the phenomenon of phagocytosis, which has of late been brought so prominently before the public in its relation to the cure of infectious disease.

That such abnormal substances may occur in the blood is shown in a beautiful series of pictures of its condition in relapsing fever. After we have been made familiar with the appearance of normal blood, in which the red corpuscles appear as brilliant rings and the larger white cells as cloudy masses with shadowy nucleus and brightly shining granules, we see the blood as it may appear at the height of an attack of the disease. It is now full of foreign organisms, long, slender spiral threads, which dart hither and thither upon the screen, now hooking themselves together and again disentangling themselves, impinging on the red cells and recoiling in amazing numbers and activity. The whole blood history of an attack is shown on these films, from the interval between the crises when no organisms are present, through the period of multiplication to the termination of the attack with the tendency of the spirals to aggregate together and eventually disappear. Several such blood-pictures may be seen, including a most beautiful preparation of an infection with a trypanosome, a close ally of the organism which produces sleeping sickness. Here the parasite is seen in quite perfect distinctness, swarming in enormous numbers in a drop of blood with an incredible activity and energy of motion.

Technically perhaps the greatest triumph of these microkinematograph pictures are the films which show us the *Spirochaeta pallida*, the causal organism of syphilis. This delicate thread, with its many tiny spirals, is so exceedingly minute that even when motionless and stained it is difficult to see with the best of ordinary microscopes. But here it appears alive and moving, with its coils all clear and sharp, a perfectly distinct picture. Only those who know the careful pains, which are necessary to obtain a satisfactory demonstration of this tiny object, can fully appreciate the skill which has gone to the making of such photographic films as these.

We have dwelt chiefly upon the microscopic preparations which Messrs. Pathé Frères have exhibited, because they seem to us the most remarkable of those

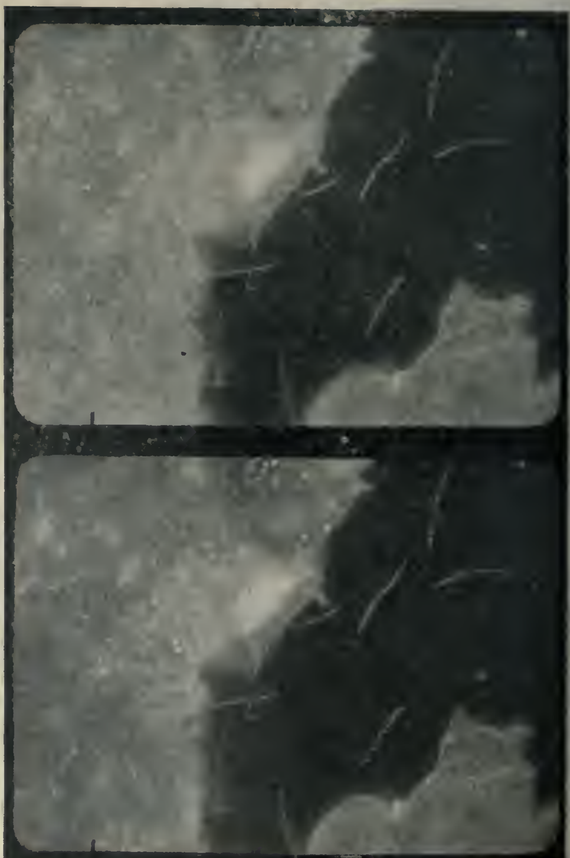


FIG. 6.—Spirochæta of Syphilis (from the cornea of the eye) enlarged.

which we have seen. But there are many other applications of kinematography to biological subjects

which are of great interest and value. Many movements in nature proceed at a rate such that we cannot successfully follow them with the eye and brain. The slow movements of a leucocyte, the gradual unfolding of a flower-bud or upward growth of a plant advance so leisurely that we cannot readily follow the change—it is only by observing them from time to time that we can appreciate that alteration is occurring. A succession of photographs, however, taken at considerable intervals, and passed rapidly in review before us, shows us as occurring in a few minutes the whole process which may take hours or days in reality, and we are better able to appreciate the nature of the phenomena because the sequence becomes more obvious. Conversely, many motions occur too fast for us to analyse them. The fact that our retina can clearly distinguish only impressions which reach it at a comparatively slow rate makes it impossible for our unaided eye to follow the sequence of many natural phenomena. By reproducing at a slower pace the changes which do occur, the kinematograph can assist us to attain a clearer perception of the nature of the alteration which is taking place, or, even if we are still unable to grasp the successive phases, a study of the film itself will enable us to follow the sequence and analyse the motion with a greater detail and a greater accuracy than any number of examinations of the natural phenomenon can possibly supply. The kinematograph therefore can give us a positive addition to the sum of our knowledge, as well as diffuse through wider circles knowledge already gained.

This latter, while perhaps the most obvious, is not the least of the functions which such moving pictures can fulfil. There are thousands of people in this country who are intimately acquainted with the cellular constituents of the blood, and their various shapes and functions, thousands who have seen the ordinary bacterial preparations or are familiar with the heart-beat and its action on the pulse, but of these thousands not one-tenth have actually seen the amœboid movements of a leucocyte or a spirillum wriggling its way between the corpuscles or the heart itself beating before their eyes. Yet these are things which it concerns them to understand, and no amount of imagination can supply the clearness and comprehension which actual seeing can give. The kinematograph might well become a most efficient aid to the teaching of very many biological, and especially medical, subjects.

The accompanying illustrations have been reproduced from kinematograph films kindly supplied for the purpose by Messrs. Pathé Frères.

THE RUBBER-PRODUCING PLANT OF THE MEXICAN DESERTS.[1]

AMONGST the botanical collections formed in 1852 by Dr. J. M. Bigelow, whilst attached to the Mexican Boundary Survey, were specimens of a shrub known to the Mexicans as "guayule," afterwards described by Prof. Asa Gray as *Parthenium argentatum*. No mention, however, was made of its rubber-bearing qualities. It was not until 1876 that public attention was directed to guayule rubber by an exhibit sent to the Centennial Exposition at Philadelphia in that year. The country peon had, it appeared, for long been in the habit of making playing balls and other articles by the "communal mastication" of the bark of this shrub, and it was by that means sufficient was obtained for the above-mentioned exhibit. Investigation showed that the plant was capable of producing in the neighbourhood of ten per cent. of its weight of dry rubber, and that it grew in vast abundance in the desert country of northern Mexico.

FIG. 1.—Foot-slope of Sierra Zuluaga.

This discovery speedily changed the economic value

[1] "Guayule (*Parthenium argentatum*, Gray), a Rubber-plant of the Chihuahuan Desert." By Prof. F. E. Lloyd. Pp. viii+213+46 plates. (Washington: Carnegie Institution, 1911.) Publication No. 139.

of these deserts, and set in motion business operations involving millions of capital based upon the amount of raw material in sight. In 1902 chemical and mechanical extraction plants were set up, and guayule rubber, though an inferior article containing a high percentage of resinous substance, soon became a very important item in the imports of the United States. At the present day the outlay of American capital in Mexico alone is said to amount to 30,000,000 dollars.

A good deal has already been written dealing with guayule, but the monograph by Prof. F. E. Lloyd is a most welcome addition to special rubber literature. Its contents are the outcome, Prof. Lloyd states in his preface, of an investigation carried out by others and himself at the instigation of certain Mexican rubber companies towards the elucidation of the question of the profitable cultivation of guayule in the desert with a view to future maintenance of supplies.

In addition to the physiology of the plant under and Prof. Lloyd estimates that existing supplies will be exhausted in a few years' time. Seed can be germinated and plants easily raised by giving a small amount of shade and subsurface irrigation. On p. 121 the author remarks that "the most fundamental economic question for which an answer will be sought in these pages is that relating to the production of rubber under irrigation." In searching for a reply one has to be content with the statement that "The less the water the thicker the bark (cortex) and *vice-versa*." Irrigated plants naturally grow more vigorously but produce wood at the expense of cortical tissues, and it is largely the latter from which the rubber is extracted.

The book is evidence of a vast amount of labour undertaken in the spirit of enthusiasm, but its utility for the general reader is curtailed by the want of condensation in dealing with experiments and tabular results, and the absence of definite statements or deductive conclusions. It is elaborately illustrated by photo-litho plates, containing a large number of photo-

FIG. 2.—Guayule in a very dense growth.

varied conditions, the main subjects dealt with are questions of climate and soil, seed germination, methods of reproduction, results of cropping, environment of the plant, its rate of growth, methods of extraction, the possibility of maintaining the supply by irrigation, and the effects of this upon the yield of rubber. In the course of the investigation attempts are made to throw light upon many interesting problems in connection with the physiology of desert vegetation.

Much attention has been given to the formation of resin and rubber, and the close connection between the two. There appears to be no tube-like laticiferous system as in other rubber-yielding plants, the rubber being formed apparently in the cells of the resin-canals, whilst the resin itself is found only in the canals and not in the cells.

The guayule shrub is a very slow grower, a fifteen-year-old plant being no more than 15 inches in height,

graphs and line-drawings of the minute histological structure of the different parts of the plant, as well as by some fine photographs of desert surroundings.

THE AËRONAUTICAL BLUE-BOOK FOR 1910–11.[1]

THE specific questions which form the subject of the experiments and observations described in this report may be briefly described as follows:—

The deviation of air resistances from the law of proportionality to the square of the velocity and the effects of friction in this connection—discussed theoretically by Lord Rayleigh and experimentally by Messrs. Bairstow, Booth, Dr. Stanton, and Mr. Pannell.

[1] Technical Reports of the Advisory Committee for Aëronautics for the Year 1910–11 (with Appendices). Pp. 134. (Published by his Majesty's Stationery Office. London: Wyman and Sons; Edinburgh: Oliver and Boyd; Dublin: E. Ponsonby, Ltd., 1911). Price 6s.

Theorems on stresses in envelopes by Mr. Booth.

Forces and couples on a model dirigible placed obliquely to the current by Mr. Bairstow.

Air resistances of wires and ropes, both stationary and vibrating, by Mr. Melvill Jones and Dr. Stanton.

Air pressures on the honeycombed radiator and Paulhan girder.

Methods of observing flow of water past an obstacle by Mr. Eden.

Propeller experiments by Mr. Bairstow.

Tests of balloon fabrics.

Meteorological apparatus by Mr. J. S. Dines.

The present report is characterised by greater definiteness of purpose than was noticeable in its predecessor for 1909–10. Many of the papers have a direct bearing on aërial navigation, and we do not exclude Mr. Bairstow's experiments on square plates altogether from this category, since if it is required to test the deviations from the law of proportion of pressure to square of velocity, the first tests may as well be made on square plates as on any other kind of surface. The experiments on obliquely placed model dirigibles also have an important bearing on the problems of stability and steering as applied to airships, and the necessity for such investigations is fairly evident. At the same time, the superfluity of diagrammatic details which was referred to in the review of the preceding year's report is also to some extent a conspicuous feature of the present volume, and it again appears desirable to direct attention to the fact that some of these are wholly unnecessary and only occupy space that could be with greater advantage devoted to broad and general discussions by the members of the committee on the principles of mechanical flight, considered in relation to the experiments here described. The three and one-third pages of description of Mr. Dines's theodolite would probably be just as useful without the three folded diagrams, one taken at Pyrton Hill in a clear sky, and one showing the observations by Cary at station A, and Bosch at station B, up to the point where a certain pilot balloon was lost sight of.

The article on propellers, while accompanied by six bulky folding plates, only occupies four pages of letterpress. One of these is devoted to "improvements in apparatus"—not improvements in propellers, but in the dynamometers and other instruments for testing them, while the remainder are principally devoted to determining the constants and coefficients of a Vickers and Maxim, and three Ratmanoff propellers. Certain conclusions are stated, referring in particular to the effects of cutting down the blade area, and the extent to which the principle of similarity can be applied to models. But surely there is a great deal more to be said about the general problem of propeller action, even in connection with the interpretation of the results of these experiments, and it is desirable that the investigation should be extended to other types of propeller than the two here discussed. Perhaps this will be done another year.

In making these criticisms it is necessary to guard against one serious mistake which is commonly made, and does much to retard scientific progress and development. It is frequently said of certain physical investigations that they are of no use because they do not take into account all the disturbing factors which exist in nature. As applied to aviation, we are told by some people that it is no use to investigate the efficiency of planes and propellers by laboratory experiments, as the investigations fail to take account of the atmospheric disturbances which affect the motion of an actual aëroplane. This, however, is equivalent to saying that we require to know less about the efficiency of our apparatus under the complex conditions prevailing in nature than we should if the conditions were simpler. In reality we ought to know *more*, and experiments made under ideal conditions instead of being condemned as "unnecessary," should be described as "insufficient," and should therefore be pushed on with all possible haste as a preliminary step to investigations of a more general character.

In view of the desirability of using experiments with models for all they are worth, and the success which has attended such experiments in naval architecture, it is satisfactory to find that the principle of dynamical similarity is receiving considerable attention. At the same time, one has rather an idea that the atmospheric conditions under which aëroplanes and dirigibles are navigated are rather different from those existing in the National Physical Laboratory, and the idea suggests itself that, instead of trying to produce a current of air that shall be as nearly uniform as possible, results equally interesting would be obtained if it were attempted to do the very opposite thing. When so many physical data are unknown even to within 100 per cent., it surely is rather unnecessary to trouble about whether a velocity of 1·6 or 2·1 miles an hour is set up in the air when a rotating arm is travelling through it at thirty-five miles an hour. A study of the "wash" or interference effects caused by planes or propellers on other planes or propellers following in their wake would be more useful. For example, the lift and drift of the isolated Paulhan girder determined on p. 36 may for this reason be different from the values which they would have when the girder occupied its proper place in an actual flying-machine.

There are two possible alternatives. One is (following the usual custom) to disparage such researches as those last-named; the other is to ask for something more. The latter alternative certainly appears from every point of view to be the better.

The collection of abstracts of papers on aëronautics, compiled from various English and foreign journals, extends from p. 92 to p. 124, and is an exceedingly valuable feature of this, as it was of last year's report. The preparation of such abstracts involves an expenditure of time and thought, on the part of the abstractors, which, as a rule, receives but scanty recognition. The idea suggests itself whether some working arrangement could be arrived at between the Government Committee and the Aëronautical Society to enable the abstracts to be reprinted in the Journal of the latter, and thus circulated among its members at regular intervals. Perhaps this question may be deferred until the Aëronautical Society has had time to settle down after the arduous work of reorganisation on which its council has recently been engaged.

SIGHT TESTS IN THE MERCANTILE MARINE.

THE Board of Trade has published the annual return of the sight tests used in the mercantile marine for the year ending December 31, 1910 (Parliamentary Paper, Cd. 5876), a return which includes the examinations in both form and colour vision. In the course of the year 7502 candidates were examined, including fishermen who sought to obtain certificates as skipper or second hand of fishing boats, and of this total 109 (1·46 per cent.) failed in form vision, and one of them, who was re-examined, failed again. One hundred and forty-one failed in colour vision, but of these 69 were re-examined on appeal, and 29 of them passed, leaving 112 (1·56 per cent.) as ultimate failures.

The colour examination, since November, 1909, has been conducted with five skeins of wool, a purple and

a yellow, in addition to the green, pink, and red originally used by Holmgren; and a coloured plate gives the colours which were selected as matches by the rejected candidates, and are distinguished by letters of reference in a schedule showing the performances of all the candidates who were ultimately rejected, and are therein described as completely or incompletely red or green blind. This information, however, is withheld in the very cases in which it is most required, that is, in the cases of candidates who, having originally been rejected, were passed on appeal. With regard to these, we are only told that they "failed in the colour vision tests," and, in another column, that they "appealed and passed." It would be highly interesting to know both on what grounds they were originally rejected and on what grounds they were ultimately passed, because these are the very cases in which the sufficiency of the methods of examination employed may possibly be called in question at some future time. The matter is perhaps of less importance, as we read in the report that "the whole question of sight tests is now being carefully considered by a Departmental Committee appointed for the purpose," and it is therefore possible that changes both of procedure and of record may be suggested.

Of the 112 men rejected for defective colour vision, 42 were completely and 21 incompletely green blind, and 32 were completely and 17 incompletely red blind, no instances of the rarer varieties of failure being recorded. The rejections are somewhat in excess of those of many previous years, and the explanation seems to be that the fishermen seeking certificates, as mentioned above, have only been required to pass the same sight tests as candidates for certificates as masters or mates in the mercantile marine since November, 1909, and that they have increased the proportion of defectives. As compared with the amount of defective colour-sense in the population generally, the proportion of rejections does not seem large, and it is highly probable that many colour-blind persons are prevented, by a knowledge of their condition, from attempting to enter the sea service.

WIND IN THE ADRIATIC AND IN HOLLAND.[1]

THERE has been in recent years a re-awakened interest in the problem of the periodic variations of the wind, but there remains much to be done to complete that thorough harmonic analysis of the motion of the air which Kelvin emphasised as one of the most important lines of meteorological research so long ago as 1876. Hitherto attention has been devoted mainly to a consideration of the semi-diurnal variation, and the results have shown conclusively that the regular semi-diurnal wave of pressure can, as indeed it must, be connected through the hydrodynamical equations with a similar regular variation of the wind-vector. In the discussion of the record for individual places, the question of the local variations from the general law and their explanation rightly find a place, but they ought not to be allowed to exclude the consideration of other possible periods.

In the first chapter before us, Dr. Mazelle, Director of the Observatory at Trieste, analyses five years' records from the Beckley anemograph erected in 1902 on a lighthouse in the Adriatic, the Klipper Porer, which lies a mile and a half W.S.W. of Cape Promontore, the most southerly point of Istria. The results have been very fully discussed, and the records are arranged and tabulated in many different ways to exhibit the different features inherent in them. A table giving the frequency of the wind for sixteen directions for the four seasons of the year shows that at all times the E.N.E. wind is most frequent, and that all easterly winds have their maximum frequency in winter and spring, while westerly winds are more frequent in summer and autumn. Another table, giving the diurnal variation of the frequency of the wind for the eight principal directions, shows that N.E. winds are most frequent about 3 a.m., and W. winds about 3 p.m., a result which may arise from land and sea breezes.

Diagrams are drawn to show the diurnal variation of the wind-vector for the four seasons and for the whole year. In general the vector rotates in a clockwise direction in the course of the day, but in winter the curve is looped and the rotation is counter-clockwise from 3 p.m. to 3 a.m. The variation is greatest during summer, and is greater in spring than in autumn. It would have been an advantage if the results had been analysed for the four principal directions, instead of for N.E., S.E., N.W., S.W., in order to permit of direct comparison with results from other places and with theory.

A considerable part of the paper is devoted to a discussion of strong winds or gales, especially gales from the N.E. quadrant, Bora, and from the S.E. quadrant, Scirocco. Dr. Mazelle takes a stormy day to be one on which the mean velocity of the wind is at least 50 kilometres per hour. There were 149 such days in the five years, or, roughly, one day in twelve. January had 33 such days, or rather more than one in five. June, on the other hand, had only one such day in the whole period. A curious and suggestive peculiarity is the secondary maximum in October, which had 18 stormy days, compared with 11 in September and November. The diurnal variation on a stormy day is about the same in summer as in winter, the maximum occurring at or slightly before noon in both seasons. For days of stormy Bora and Scirocco the definition is extended to include days on which the maximum velocity exceeded 50 kilometres per hour. There were 233 days of stormy Bora and 71 of Scirocco during the five years, a result which does not altogether support Horace's description of Scirocco or Notus as "arbiter Hadriae," "that tumultuous ruler of the restless Adriatic." Bora is most frequent in winter, the worst month being January, with an average of eight days; Scirocco is most frequent in autumn, with a maximum monthly average of 2·6 days in October. In every month the average number of days of Bora is greater than that of Scirocco.

Perhaps the best idea of the character of Bora and Scirocco is given by tables showing the length of the periods during which the mean velocity exceeded 50 kilometres per hour, and of periods during which the velocity never fell below 50 kilometres per hour. It is seen from these that on one occasion of Bora the wind blew uninterruptedly with a velocity exceeding 50 kilometres per hour for 144 hours, and that on the same occasion the mean velocity did not fall below 50 kilometres per hour for 7 days. The corresponding maximum periods of duration for Scirocco are 36 hours and 3 days. The absolute maximum velocity recorded during the five years was 128 kilometres per hour for Bora, 102 for Scirocco, 98 for S.W. gales, and 80 for N.W. gales. Unfortunately, the factor of reduction is not stated, so that it is not possible to compare these values with records for this country.

The second paper is a discussion contributed by

[1] "Die tägliche Periode der Windrichtung und Windstärke nach den anemometrischen Aufzeichnungen auf der Klippe Porer." By E. Mazelle. Besonders Abgedruckt aus dem lxxxvii. Bande der Denkschriften der Mathematisch-Naturwissenschaftlichen Klasse der Kaiserlichen Akademie der Wissenschaften. Pp. 65. (Wien: Alfred Hölder, 1911.)

"On the Diurnal Variation of the Wind and the Atmospheric Pressure and their Relation to the Variation of the Gradient." By Dr. J. P. van der Stok. Pp. 14. Koninklijke Akademie van Wetenschappen te Amsterdam. Reprinted from Proceedings of the Meeting of May 27, 1911.

Dr. J. P. van der Stok to the Proceedings of the Royal Academy at Amsterdam, "On the diurnal variation of the wind and the atmospheric pressure and their relation to the variation of the gradient." He criticises the method, adopted in previous investigations, of attempting to determine the variation of the wind from the variation of the gradient of pressure, and, regarding it as too laborious and affected with uncertain errors, attempts to determine the gradient from the observed variation of the wind. It would be interesting to institute a comparison between this method, that of utilising hourly observations of pressure at three stations, adopted by Tsuiji, and the general method based upon the regularity of the semi-diurnal wave of pressure.

Dr. van der Stok finds it convenient to assume that the semi-diurnal variation of the wind has the same phase angle as would be indicated by the theoretical application of the general method, and deduces the value of the coefficient of friction, *k*, which will ensure agreement between observation and theory in this respect. He then utilises this value of the coefficient to deduce the diurnal variation of the gradient of pressure from the observed diurnal variation of the wind. It seems desirable to consider in this application the difference, emphasised in a recent paper by Sandström, between friction due to motion over the rough surface of the earth and sea and the frictional effect which arises from the difference in direction and velocity between the wind at the surface and that at some distance above it. The results used in the investigation are the hourly observations, presumably estimates and not instrumental records, at de Bilt for five years 1903–1908, and the four-hourly observations at the Terschellingerbank Lightship for 25 years 1884–1908. The values found for *k* show a general agreement with those found by van Everdingen from the incurvature of the wind at de Bilt, but the value for Terschellingerbank is 50 per cent. larger. The coefficient shows a regular annual variation, with the maximum during autumn and winter, the minimum during spring and summer, an interesting result which ought to be compared with the values for inland stations. The author criticises the results of the analysis at St. Helena, on the ground that the wind-vector turns in a clockwise instead of in a counter-clockwise direction, but a reference to Dines's discussion of these results shows that, except for certain small irregularities in the night, the vector rotates in a counter-clockwise direction throughout the year. The vector of the variation of the horizontal magnetic force at St. Helena rotates in a clockwise direction except in July.

E. GOLD.

REPORT OF THE GOVERNMENT CHEMIST.

IN his report upon the work of the Government Laboratory for the year ended March 31, 1911, the principal chemist notes that the laboratory has now been constituted a distinct establishment under the Treasury. This is certainly a more appropriate arrangement than the previous one, under which the control was vested in the revenue authorities, for since the laboratory now serves many other State departments besides the fiscal ones, the control in question had become somewhat of an anachronism.

Last year the total number of samples dealt with was 186,044, as compared with 170,033 in the preceding year. The report describes the nature of these, with explanatory notes and statistics. As usual, they included the most diverse kinds of articles, from "standard" bread to poisoned salmon. From among the items of more or less general interest mentioned in the report we extract the following.

Beer and brewing materials are regularly tested for the presence of arsenic, and 41 out of 638 samples were found to contain arsenic in excess of the prescribed limit. Steps were taken in these cases to prevent the contaminated article being sent into consumption, and to trace the source of the arsenic. Usually this was found in the fuel used for drying the malt.

Two interesting cases of fish-poisoning are noted. In one instance dead trout were found (Kensey Brook, Tamar and Plym District), and analysis of the water showed that the brook had been contaminated with ammonia from a gas works. In the other case, dead salmon had been found in the Conway district, and as there are lead mines near it was thought that the fish might have been poisoned by drainage containing lead. On analysis, however, zinc, and not lead, was discovered in the salmon, as also in the river water; this served to indicate the source of the pollution and explain the destruction of the fish.

One curious question referred to the laboratory was whether the composition of a particular clay was such as to distinguish it from the exempted "common clay" of the Finance Act of 1909–10; the report is silent as to the conclusion arrived at. Questions connected with the pigments, paper, and gum used in making postage and other fiscal stamps were also investigated. At the house of a coiner, it is stated, a plate and apparatus were found, all ready for the production of illegal stamps. "His productions were somewhat crude," the principal chemist remarks; "but were sufficiently good to deceive an unobservant person, especially in a poor light."

In connection with dangerous trades a number of pottery glazes were examined. They included a series of forty-eight taken from works where lead-poisoning had occurred, and it is a significant fact that except in two or three cases, practically the whole of the lead in these samples was "soluble" lead. Large proportions of lead were also found in dust collected from various factories, other than potteries.

Space allows mention of only one more of the many interesting matters to be found in the report. A question arose respecting the authenticity of a portion of an "Account Book of Revels" of the years 1604–5, preserved in the Public Record Office. This document is a manuscript containing details of expenses incurred in producing certain plays, including *Othello*, respecting the production of which at so early a date there has been much controversy. Suspicion had been cast upon the manuscript, the suggestion being that the entries in question had been made about forty years ago, just before the book had passed into the custody of the Record Office. "After a searching microscopical and chemical examination of the ink and paper in different parts of the document," the principal chemist was able to report that in the character of the ink, the depth to which it had penetrated, or the degree of fading, there was no evidence whatever of any difference between the impugned writing and that in other parts of the document.

C. S.

PRINCE BONAPARTE'S AIDS TO SCIENTIFIC WORK.

THE announcement of the gift of 250,000 francs to the Paris Academy of Sciences by Prince Roland Bonaparte has already been made in these columns. The issue of the *Comptes rendus* of the Academy for November 27 includes a copy of the letter from Prince Bonaparte to the president of the Academy, M. Armand Gautier, announcing his intention, and also the remarks of the president after reading this letter to the meeting of the Academy. A free translation of both is subjoined.

In accordance with a feeling expressed many times, I have arrived at the conclusion that it is not by the institution of new prizes with the conditions of award fixed beforehand that the cause of scientific progress can be served most effectively. Undoubtedly it is an excellent thing to reward good work, but it is of greater importance to encourage the growth of original investigation by removing those obstacles which are apt to paralyse the peace of mind of men engaged in research work, of which the principal is generally the question of ways and means.

Impelled by this idea, I created in 1908 the Fonds Bonaparte. Anxious to continue this work, I am placing at the disposal of the academy a further sum of 250,000 francs, not as a capital sum, but in the form of five annuities, intended to be used at once in the spirit I have indicated; that is to say, putting aside all idea of recompense for work accomplished already, whatever its merit may be, my wish is that this sum may be used to stimulate discoveries by rendering easier the researches of workers in science who, having already given proof of their ability to undertake original work, and not belonging to our academy, lack sufficient resources to undertake or to follow out their investigations.

I therefore ask the academy to allocate in 1912, 1913, 1914, 1915, and 1916 these new annuities in the same manner that it has already, in previous years, dealt with the earlier annuities of the Fonds Bonaparte.

Devoted as I am to all scientific studies, I shall be happy, and my object will be gained, if I can in this way help to increase the amount of positive knowledge.

The president said:—

I do not think I need ask the academy to give its approval to this further liberality that Prince Roland Bonaparte offers us to-day. The academy accepts the gift with gratitude.

Not satisfied with continuing to help, as he has done for the last four years, young men of science who might have been stopped in their researches by material difficulties, our colleague doubles the amount which he places at their disposal by making it 50,000 francs a year for five more years. The number and value of the researches which his gifts have made possible during the four years which are almost at an end lead us to hope that the results will be still better for the new period which begins in 1912.

With its president, the academy and French science thank Prince Roland Bonaparte very heartily for his generosity and invaluable initiative.

NOTES.

We notice with deep regret the announcement of the death, on Sunday, December 10, at ninety-four years of age, of Sir Joseph D. Hooker, O.M., F.R.S. In the scientific world he occupied a place in the front rank, and his name and work will be permanently prominent in the history of scientific progress in modern times. Thirty-four years ago, on October 25, 1877, an appreciative article on his services to science was contributed to our columns by Prof. Asa Gray in the eleventh article of our series of Scientific Worthies. We need only refer to that article now as an indication of the high esteem in which Sir Joseph's unusual gifts and energies have long been held by those most competent to estimate their value. We hope in our next issue to supplement this article with another, and here only remark that his botanical knowledge was unrivalled, and his work has won the gratitude of the whole civilised world. The announcement was made on Tuesday that the Dean of Westminster had, with the full concurrence of the Chapter, offered to the family to permit the interment of Sir Joseph Hooker's ashes in the Abbey, on the condition that his remains were previously cremated. It would have been appropriate for his remains to rest in the north aisle of Westminster Abbey among those of Newton, Sir John Herschel, Darwin, and Kelvin, and near the memorials of Adams, Stokes, and Joule. The family has, however, felt obliged to decline the offer of burial in the Abbey, as it was Sir Joseph's express wish that he should be buried by the side of his father at Kew. The funeral will therefore take place at Kew Parish Church to-morrow (Friday) at two o'clock. It is specially requested that no flowers be sent.

The list of honours conferred by the King on the occasion of his Majesty's visit to India, and in commemoration of the Coronation, is published in a supplement to *The London Gazette* of December 8. Among the names in the list are those of several people concerned with scientific work. We notice the following in a long list of appointments and promotions:—*K.C.S.I.:* Surgeon-General C. P. Lukis, Director-General, Indian Medical Service. *C.S.I.:* Colonel S. G. Burrard, F.R.S., Officiating Surveyor-General of India; Mr. F. B. Bryant, Inspector-General of Forests to the Government of India; Dr. G. T. Walker, F.R.S., Director-General of Indian Observatories; Prof. J. C. Bose, Presidency College, Calcutta. *K.C.I.E.:* Mr. Eardley-Wilmot, lately Inspector-General of Forests to the Government of India. *C.I.E.:* Major Leonard Rogers, professor of pathology, Medical College, Calcutta, and bacteriologist to the Government of India; Mr. H. H. Hayden, Director of the Geological Survey of India. *Knights Bachelor:* Mr. R. P. Ashton, president of the Mining and Geological Institute, Calcutta; Lieut.-Colonel C. H. Bedford, Chemical Examiner, Bengal.

The Nobel prizes were distributed by the King of Sweden on December 10. Three of the prize-winners—Mme. Curie (chemistry), Prof. W. Wien (physics), and Prof. A. Gullstrand (medicine)—were present personally to receive their prizes.

We regret to announce the death, on December 11, after a very short illness, of Mr. William Thynne Lynn. The son of a physician in Westminster Hospital, he was born at Chelsea in 1835. He was for a short time assistant in the Cambridge Observatory, and was assistant at the Royal Observatory, Greenwich, from 1856 to 1880, when he retired from official duties. He was elected a fellow of the Royal Astronomical Society in 1862, and contributed several papers to the Monthly Notices. In 1900 he became a member of the British Astronomical Association, was the author of many papers in its Journal, and was a member of the council at the time of his death. He was associated with Prof. D. P. Todd in the authorship of "Stars and Telescopes," and, among other works, wrote the popular little treatises "Celestial Motions," "Remarkable Comets," and "Remarkable Eclipses," each of which ran through several editions. He was a constant contributor to *The Athenaeum*, *Observatory*, and other journals, principally on subjects connected with the history of astronomy and the calendar, and occasionally contributed to our pages. His knowledge of astronomy generally, and especially of its history, was unusually extensive. On subjects connected with chronology he was also extremely well informed, and was always ready to place his knowledge at the service of others.

We regret to learn of the death of Mr. H. Snowden Ward, which took place in New York about a week ago, after an exceedingly short illness. Mr. Snowden Ward was a journalist and publisher who was well known in this country as being energetically interested in all branches of photography, but especially in the progress of methods of photomechanical reproduction, and, later, in the advance of pictorial photography. His endeavour to get the word photograph, when used as a substantive, replaced by "photogram," which he maintained was more correct, was always kept to the front by the name of his monthly

journal *The Photogram* and his annual "Photograms of the Year." Of late years Mr. Snowden Ward, while continuing his journalistic work, studied the life and writings of Charles Dickens, with special reference to the actual places and circumstances referred to by the novelist. He was giving lectures on this subject in the United States when he was taken ill. He was only forty-six years of age.

THE death is announced, at fifty-two years of age, of Dr. E. F. Trevelyan, formerly professor of therapeutics at the University of Leeds, and professor of pathology at the Yorkshire College, then a constituent of the Victoria University.

PROF. G. ELLIOT SMITH, F.R.S., professor of anatomy in the University of Manchester, has been awarded by the Paris Anthropological Society the Prix Fauvelle, of one thousand francs, for his researches in the anatomy and physiology of the nervous system.

PROF. F. B. LOOMIS, who left Amherst College, Mass., in July at the head of an exploring expedition to Patagonia, has written to a colleague an outline of his progress up to the beginning of October. He had not been able to secure many fossils, but could already see that the expedition would be able to revise the geology of the country traversed. Many of the beds previously described as land deposits were, in his judgment, marine.

THE death is announced, on December 5 at Gloucester, in his seventy-eighth year, of Dr. Francis T. Bond, for thirty-eight years medical officer to the Gloucestershire combined sanitary district. Dr. Bond was formerly professor of clinical medicine at Queen's Hospital, Birmingham. From 1862 to 1873 he was principal of the Hartley Institute, Southampton. He translated Radicke's work on "Medical Statistics," and was a frequent contributor to medical and sanitary journals. Dr. Bond was an early worker in bacteriological research and was interested in scientific agriculture; he elaborated a method of cheese manufacture, and invented a filter and other hygienic devices.

THE presentation of the testimonial to Mr. Henry Keeping on his retirement from the post of curator of the Geological Museum, Cambridge, took place in the Sedgwick Museum on Saturday, December 2, when Prof. T. McKenny Hughes handed him a purse subscribed by old friends and students in recognition of his long and valuable services. Mr. Keeping entered upon his duties as curator fifty years ago under Prof. Sedgwick in the old Woodwardian Museum, where the geological department was located until its removal into the Sedgwick Museum in 1904. In collecting fossils in the field Mr. Keeping has displayed exceptional ability and skill; and amongst the mass of specimens which he has thus added to the museum special mention should be made of the remarkably rich series of Tertiary fossils from the Hampshire basin which his keen eye and intimate knowledge of the beds of that area have enabled him to obtain.

AN interesting discovery is reported from Western Canada. During the summer Mr. Andrew Gordon French discovered what is claimed to be one of the largest mines of reef platinum metals in the world in the dyke rocks of the Nelson district, British Columbia. He has now announced the discovery therein of a new element, to which he has given the name Canadium. The element is described as a new member of the family of noble metals, with a melting point somewhat lower than that of silver and gold, possessing a brilliant white lustre, easily soluble in hydrochloric and in nitric acids, not tarnished by damp air, sulphuretted hydrogen, alkaline sulphides, or tincture of iodine, and not precipitated from its solutions by chlorides or iodides. Continued heating in the oxidising flame does not oxidise the molten metal, though some specimens, when first heated, give off dense fumes, which may be due to osmium, or possibly to something also new. It is electronegative to silver, is precipitated from its solutions by zinc, and, when alloyed with lead, may be separated by cupellation. The metal occurs pure as semicrystalline grains, and in short rods about 0·5 mm. long and 0·1 mm. thick, and also alloyed with the other platinum metals. Quantities up to 3 oz. per ton have been found in the rock. It is more brilliant and lustrous than palladium, and softer than platinum, ruthenium, and osmium. The new metal is thus well characterised and clearly differentiated in properties from all known substances, and the confirmation of the discovery will be awaited with interest. Mr. French has had wide practical experience in the extraction and separation of the platinum metals with various bullion-smelting firms in this country, and is a native of Glasgow.

MR. J. C. ROBERTSON, of 119 Victoria Road, Kirkcaldy, has sent us a communication relating to recent proposals for the reform of the calendar. For the most part his remarks add little to the information conveyed in our articles of April 27 and October 26. But he also takes occasion to advocate the setting back of the year by ten days in order that its beginning may coincide with the winter solstice. This suggestion cannot be supported on the ground of any advantage in commercial affairs, and the chief interest which it has for us lies in the light which it throws on the mental attitude of the prominent reformers. In criticism of the provisions of the Fixed Calendar Bill, we suggested the case of a servant engaged on March 32, and wished to know the date of the first monthly payment and the rule for calculating its amount. On the first point Mr. Robertson confirms our surmise that the due date is April 28. This, it may be observed, implies that in practice a month may be any period from twenty-eight to thirty-five days—a truly great improvement on our present system! He then suggests that the payment will be by special agreement one-twelfth of the annual wage. But again it is difficult to appreciate the simplicity of a calendar which needs to be supplemented by special agreements. Alternatively, he states that the Bill provides that the payment shall be in proportion to the length of service. We believe that according to the Bill payment should be in proportion to the number of weeks in the month. When, as in the case suggested, a fraction of a week is involved, we were at a loss for a rule, and Mr. Robertson has not convinced us that the Bill is explicit on the point. We have no wish to press this simple example too far, but we do think that the reformers have altogether underrated the practical difficulties of the problem and undervalued the legitimate objections which can be brought against their solution of it.

MR. HERON-ALLEN informs us that the violent gales at the end of November have enabled him to make two very remarkable finds at Selsey, near Chichester. One is a series of Proteoliths in the seldom exposed Pleistocene mud bed on the west coast, which Sir Ray Lankester pronounces to be of the rostro-carinate eagles's-beak form, similar in shape and date to the sub-Crag Proteoliths of which frequent mention has been made in these pages. Mr Heron-Allen is handing them all over, together with the Selsey Palæoliths and Mesoliths, to Sir Ray Lankester,

who is at work on this subject. The other "find" is a British gold stater, dished and plain on one side, and bearing on the other the impress of a die not to be found in Willett's or Evans's works, and which, until Mr. Heron-Allen deposited his coin at the British Museum, was unknown and unrepresented in the national collection.

In describing (*Archaeologia Æliana*, ser. 3, vol. vii.) the animal remains obtained during the excavations on the site of the Roman city of Corstopitum, near Newcastle-upon-Tyne, in 1910, Messrs. A. Meek and R. A. H. Gray state that the bones and skulls of many of the oxen agree very closely with those of the white cattle of Chillingham and other British parks. A peculiarity said to characterise both is the absence or early shedding of the antepenultimate lower premolar. On this ground both the Chillingham and the Roman cattle are declared to represent a new wild species, for which the name *Bos sylvestris* is proposed; but whether this is typified by the former or the latter the reader is left to decide for himself. They ignore the fact that park-cattle already possess a scientific name —*Urus scoticus* of Hamilton Smith—and likewise that the colour of these cattle is decisive as to their domesticated origin. Most naturalists would likewise regard the alleged absence of the anterior premolar as a feature due to domestication.

In a study of the Pacific Ocean in its relation to ethnography, contributed by Dr. J. M. Brown, regent of the University of New Zealand, to part i., vol. ii., of *The Journal of Race Development*, the writer lays special stress on the region of subsidence. This he believes to account for one of the most singular phenomena in human culture. "These central groups are occupied by a people, the Polynesians, who in some of their arts, the masculine, those of war, navigation, architecture, and carving, rise to the highest levels of the barbaric stage. And yet they have adhered to arts that are purely Palæolithic: these are the art of thread-making, that of fire-making, and the fictile art; they have never had a spindle: they have a pump-drill, but they have never applied it to the production of fire; and though they have plenty of clay, they have never made pottery. In early stages of culture these belong to the women's department, and woman, guided as she is by emotion oftener than by reason, is more conservative than man. This Palæolithic element in the household culture seems to indicate that man has been in Polynesia since Palæolithic times, and that woman came into those regions only in those times, when there were still only short canoe voyages to make to land that could be seen on the horizon."

Nos. 46 and 47 of the Scientific Memoirs of the Government of India deal respectively with "Malaria in the Punjab," by Major Christophers, and "Dysentery and Liver Abscess in Bombay," by Major Greig and Captain Wells. Malaria in the Punjab is manifested in two ways, as "endemic malaria" and as "autumnal epidemic or fulminant malaria," the latter—the more important—being associated with a high mortality. The determining causes of epidemics are excessive rainfall and scarcity, though the epidemic areas are not necessarily coincident with those of heaviest rainfall. The determining factor of epidemic and fulminant malaria is found to be flooding, and the villages are attacked almost exactly in proportion as they have been flooded. Experiments with sparrows and the Proteosoma, a parasite analogous to the malaria parasite of man, and similarly conveyed by mosquitoes, show that severity of infection is largely dependent on the dose inoculated, and the latter depends not merely on the number of mosquitoes biting, but on the number of sporozoites injected at each bite, and this, again, depends on the richness in parasites of the blood of the individual from whom the mosquito derives the infection. The memoir contains a number of plans and illustrative charts. As regards Memoir 47, on dysentery, though bacillary dysentery occurs in Bombay, it is infrequent, and the form associated with amœbæ is more prevalent. The prevalence of amœbæ shows a marked seasonal variation, which follows the humidity, and not the temperature, curve in Bombay. The amœbæ can be cultivated, and are not *Ent. histolytica* or *coli*, but are probably the same form as that observed by Noc in Cochin China. Apparently the same amœbæ can be cultivated from tap water in the districts, and the evidence at present available indicates that water is probably the channel by which this form of dysentery is disseminated.

To vol. iv., part iii., of the Transactions of the Hull Scientific and Field Naturalists' Club, Mr. T. Sheppard contributes notes on the post-glacial, glacial, and pre-glacial faunas of East Yorkshire. The glacial beds have yielded remains of mammoth, straight-tusked elephant, elk, reindeer, red deer, Pleistocene bison, aurochs, rhinoceros, and walrus.

The question of the nature of the diet of the extinct giant phalanger (*Thylacoleo carnifex*) has been incidentally revived by Messrs. Baldwin Spencer and R. H. Walcott in a discussion as to the origin of cuts on bones of extinct Australian marsupials (Proc. R. Soc. Victoria, vol. xxiv., pp. 92–123). Such incised bones occur at considerable depths—sometimes beneath beds of tufa—and the authors consider that the cuts were probably made by the teeth of Thylacoleo. The name given to the giant phalanger by Owen indicated his opinion as to its carnivorous habits; but this view was disputed in 1868 by Sir W. H. Flower, who thought that its diet was probably vegetarian, although it might have included flesh. Thirty years later Dr. R. Broom argued that Owen was right; and if Messrs. Spencer and Walcott are correct in their view as to the origin of the aforesaid cuts, the carnivorous habits of the giant phalanger are definitely proved.

In the volume on mammals in the "Fauna of British India," the late Dr. W. T. Blanford stated that the black-buck (*Antilope cervicapra*) living on a spit of sand between the Chilka Salt Lake, in Orissa, and the sea, never drank, as there is no water on the spit except in deep wells. The statement has been strongly controverted by various writers, one at least of whom has suggested that the antelopes obtain water from sheep-troughs. Of late years it has, however, been conclusively shown that giraffes, kudu, and gemsbok live for a considerable portion of the year in the Kalahari Desert without drinking, obtaining such moisture as they require from the succulent roots of certain plants. In a letter published in *The Field* of November 25 Dr. Drake-Brockman records a very similar instance in the case of the maritime gazelle (*Gazella pelzelni*) in Somaliland. In July, 1910, five of these gazelles were placed on the island of Saad-ud-din, which is absolutely waterless save on the rare occasions when showers fall. There is, however, a succulent Schweinfurthia, of which the gazelles are fond, and a lily with a large onion-like root, which is scraped out of the sand and eaten by the gazelles. These are absolutely the only sources of moisture obtainable by the antelopes, which have now lived on the island for about eighteen months, since it has been clearly proved, by the absence of their tracks from the shore, that they do not drink sea water. The case of the Chilka black-

buck accordingly requires reinvestigation in order to ascertain whether they too may be able to obtain moisture from plants.

THE sponge fauna of the Kola-Fjord forms the subject of a paper (with a summary in German) by Mr. L. L. Breitfuss in *Trav. (Comptes rendus) Soc. Imp. Nat. St. Petersbourg*, vol. xlii., part i. In the second fasciculus of the same part Dr. Weltner describes (as the seventh instalment of the account of the fauna of Turkestan) the sponges of the Issyk Kul (Lake Issyk) and the neighbouring rivers of the district north of the Tian Shan. These belong to the almost cosmopolitan *Ephydatia fluviatilis*, and from the fact of its occurrence in the Issyk Kul, which is about 5300 feet above sea-level, at a depth of as much as 40 metres, the species is regarded by the author as a member of the high-mountain and deep-lake fauna. At depths between 15 and 30 metres there was found from the middle of July to the end of August a form which produces sexual buds. Since, however, only a few unripe gemmules with misformed amphidiscs were then found, it is considered that the development of normal sexual gemmules must occur at some other season.

A CATALOGUE of the periodicals, Transactions of societies, and similar publications contained in the library of the Royal Botanic Garden, Edinburgh, has been compiled and published as Nos. xxvi. and xxvii. of "Notes" from the garden. With a view to the utilisation of the separate items as index slips for public or private use, the printing is limited to one side of the page.

A CONTINUATION of garden notes on new trees and shrubs, prepared by Mr. W. J. Bean, appears in *The Kew Bulletin* (No. 8). Chinese introductions include a distinct rough-stemmed bush, *Berberis verruculosa*; a beautiful hornbean, *Carpinus polyneura*; and the new conifer, *Fokienia Hodginsii*. Another interesting and rare Chinese conifer, represented at Kew by several specimens, is the lace-bark pine, *Pinus Bungeana*; a peculiarity of this tree is the white bark, but it is noted that this is a very late development, and has not yet been attained by the Kew specimens. Noteworthy, also, is the small American tree *Leitneria floridana* that by itself constitutes the family Leitneriaceæ; the wood produced is perhaps the lightest known, having a specific gravity about 0·2.

THE original homes of our cultivated plants is a matter of considerable interest to gardeners, so that Mr. A. W. Hill found an appropriate subject in the relation of South America to horticulture for a lecture before the members of the Royal Horticultural Society, that is published in the Journal (vol. xxxvii., part i.). The "monkey puzzle," *Araucaria imbricata*, emanates from Chile, and from that State or Peru have come many hardy or half-hardy shrubs, including *Berberis Darwinii*, *Azara macrophylla*, and *Drimys Winteri*. Less hardy, and therefore requiring greenhouse cultivation, are the climbers Stigmaphyllon and Tacsonia, and the wall plants *Streptosolen Jamesoni* and *Lapageria rosea*. Species of Begonia from South America have contributed materially to the development of modern garden varieties, while no less interesting are the species of Calceolaria and Fuchsia that are strongly represented on that continent, and several brilliant species of Tropæolum.

PROF. D. H CAMPBELL is well known to botanists as the author of many valuable and important memoirs on the morphology of vascular cryptogams. A recent number (No. 140) of the Publications of the Carnegie Institution of Washington embodies a connected account of the eusporangiate ferns, in which he has brought together in a very complete form the result of his researches on the comparative morphology of the Ophioglossaceæ and Marattiaceæ. The memoir, which contains 224 pages of text, and is amply illustrated by text figures and plates, is fully worthy of the high reputation of Prof. Campbell, and it will be indispensable to all students of this interesting group of plants. After an extensive account of the structure and development of a considerable number of species the author draws certain general conclusions as to the phylogenetic significance of the structures he describes. Thus, as a result of a discussion of the evolution of the vascular structure, he regards the vascular system of the stem of, *e.g.*, Marattiaceæ as a collocation of leaf bundles, and discards the "stelar" view, as it is generally held, on the ground that it obscures a right interpretation of the facts. As might have been anticipated, the author deals with the supposed origin of the eusporangiate ferns (which he regards as a primitive group) from a bryophyte stock, and the analogies and comparisons he draws between the embryo of species of Ophioglossum and of Anthoceros are striking. Naturally he does not suggest a derivation of the ferns from Anthoceros as it now exists, but he points out very cogently the remarkable features of resemblance that actually exist. All who are interested in the evidence on which the speculations respecting the ancestry of the higher plants are founded will find matter of great interest in Prof. Campbell's memoir, whilst as a repository of facts which, whatever be the fate of theories and hypotheses, will always retain their face values, the memoir forms a considerable contribution to the permanent literature of botany.

THAT branch of the United States Department of Agriculture concerned with the introduction of foreign seeds and plants has achieved success largely owing to the systematised methods of procedure and the activities of the explorers in charge. One of the latter, Mr. D. G. Fairchild, contributes to *The National Geographic Magazine* (October) a popular illustrated article in which a few of the important introductions are noted. Probably the greatest undertaking has been the importation of date-palm suckers, which have been planted in the States of Arizona and California. From India, mangoes have been imported in large variety, and are being grown in Florida, Porto Rico, and Hawaii. The production of Oriental persimmons and the cultivation of bamboos on a commercial scale are also notable enterprises, as well as the introduction of a new vegetable, "udo," *Aralia cordata*, from Japan, comparable to and said to rival asparagus.

THE report on the permanent experiment field of the Roseworthy Agricultural College, published in *The Journal of the Department of Agriculture of South Australia*, contains some very interesting results. Perhaps the most remarkable is the great increase in the wheat crop obtained by applying small dressings of superphosphates, the grain rising from twenty-one to twenty-six bushels, and the straw also showing a marked increase. Nitrate of soda did not produce anything like the effect that would be looked for in this country, a result probably to be attributed to the lack of moisture, which would operate as a limiting factor. In the same Journal it is also stated that the broom millet (*Sorghum vulgare*, var. *technicum*) can be grown profitably in certain parts of the State. Stress is rightly laid on the value of any new crop likely to widen the basis of the local agriculture. Mention is also made of the fact that varieties of wheat which have proved admirably suited to Australia were wholly unsatisfactory in Great Britain

THE third volume of results published by the Geological and Natural History Survey of Connecticut contains three bulletins, "The Lithology of Connecticut," by Prof. Barrell and Mr. G. F. Loughlin; "Catalogue of Flowering Plants and Ferns of Connecticut Growing without Cultivation," by the Committee of the Connecticut Botanical Society; and "Second Report on the Hymeniales of Connecticut," by Prof. E. A. White. One object of the Survey's publications is to enlist the interest of the general community, in which connection Prof. Barrell's "Introduction to Lithology" is noteworthy for its luminous thoroughness. The economic value of all soils is carefully investigated by Mr. Loughlin. On the same principle, the useful or deleterious properties of flowering plants and fungi receive full notice. Prof. White has made considerable experiments with mushrooms, and the number of edible and wholesome Agaricaceæ is surprisingly large. His descriptions of fungi, illustrated by some excellent photographs, are very complete. The catalogue of flowering plants and ferns comprises 2228 species; nothing that has not been authenticated is included. Distribution is uneven; Connecticut soils, being formed from transported material, often differ from the underlying rock. In the south-eastern portion of the State there is a small group belonging to the flora of the Atlantic coast plain of the middle and southern States, probably a remnant of a larger colony. Among interesting species are the dwarf mistletoe, parasitic on the black spruce; and the numerous representatives of Rhododendron and Cypripedium. In 1907 an Act of the General Assembly was put into force, by which "The Mountain Laurel, *Kalmia latifolia*, is hereby made, constituted, and declared to be the State Flower of the State of Connecticut." The prevailing difficulties of nomenclature are well illustrated in this careful list. It will, in connection with the full geological knowledge of the State, enable some investigations to be made of considerable ecological interest.

HEFT 3 of the current volume of the *Mitteilungen aus den Deutschen Schutzgebieten* is mainly devoted to the final portion of an account of the Cameroon Mountains, by Dr. K. Hassert. The hydrography is fully treated, and the distribution of water, with its remarkable inequality, is brought out. The coastal slopes have as high a rainfall as any part of the earth's surface, while the south-eastern, eastern, and northern regions are but imperfectly supplied. The fauna and vegetation are shortly described, and the inhabitants are discussed. A section on the economic products of the region, and two appendices dealing with the observations of altitude and the determination of geological specimens complete the article.

MR. V. N. LEBEDEF investigated the hydrology of the Kamchatka River in 1908–9, and has given a preliminary account in the *Isvestiya* of the Russ. Geogr. Soc., Nos. i.–v., 1911. The river is a mighty stream, being more voluminous in its lower course than the Dnieper, and discharging when low fully 42,380 cubic feet of water per second. A greater aggregate of low temperatures is required to bring it to the freezing point than any other river of Siberia, probably owing to the high temperature of the springs that feed it. It receives tribute also from the melting of the snow and ice in the mountains, while rain is of secondary importance. The lakes of eastern Kamchatka are in summer not colder than similar lakes in Europe, notwithstanding the great difference in climate, while in winter they are even warmer, because they are frozen over earlier. The stream that drains the Nerpichye Lake is, unlike most lake outlets, warmer than the air soon after the thawing of the ice. A map of the delta of the Kamchatka River with its numerous islands, channels, and creeks accompanies the article.

MR. I. KARK, who has studied the Murgab River in relation to a project for storing the surplus water in spring to be used for irrigation in summer has published the results in the *Isvestiya* of the Russ. Geogr. Soc., Nos. viii.–x., 1910. At Tashkepri the minimum discharge of the river in September is 1330 cubic feet a second, and the maximum, in March, 5608 cubic feet, while the annual flow of water is more than 694 thousand million cubic feet. The solid matter carried down by the stream, which silted up a reservoir constructed some years ago at Yolatan, is derived principally from the sand and clay of the loss deposits below Takhtabazar. Below Sultanbent and Yolatan, where the delta may be considered to begin, the load is deposited, and, raising the general level of the country, forces the river to seek a lower course westwards. Hence it is that the town of Merv has moved in the same direction. Mr. Kark suggests that borings should be executed to ascertain the practicability of obtaining water by artesian wells. These borings would also yield information regarding the depth of the solid rocks and their age.

THE meteorological chart of the North Atlantic Ocean for December, issued by the Deutsche Seewarte, gives some news received from the German Antarctic Expedition. The ship *Deutschland* left Buenos Ayres on October 7 for a position near latitude 48° S., longitude 30° W., in order to determine by soundings whether a shoal exists there, as surmised by several shipmasters. The vessel would then visit the South Sandwich Islands to explore the floor of the ocean in their vicinity, and afterwards repair to South Georgia to take in stores, &c., this month. From there it would take a direct south-east course to the neighbourhood of Coats' Land, and make the eastern part of Weddell Sea, where less pack-ice is likely to be found than in the south-western corner. If land is reached a station will be established, and the ship will endeavour to get free of the ice by March next. In the southern summer of 1912–13 it will return for the removal of the members of the expedition. Particulars of successful landing on the Antarctic shore may be looked for about April next.

IT is impossible to read the monthly issues of the Bulletin of the American Mathematical Society without realising that American mathematicians are a much more powerful and well-organised body than their fellow-workers in this country. In an article on "American Mathematics" in *The Popular Science Monthly*, Prof. G. A. Miller shows that much still remains to be done before America can occupy a position of equality with the leading mathematical centres of the world, and his remarks certainly appear to apply with even greater force to England. It may perhaps be rather doubted whether the imperfect definitions of such words as "matrix" or "algebra" given in ordinary dictionaries can be regarded as affording much conclusive evidence, since it is probable that similar defects might be found in their treatment of other branches of science; but Prof. Miller is on firmer ground when he directs attention to the absence of any popular encyclopædic works of general reference in the English language dealing with the developments and history of higher mathematics. "As the result of this lack of intermediate mathematical literature, comparatively few of our people know what constitutes a mathematician of high order."

THE Journal of the Washington Academy of Sciences for November 19 contains a short account of the results obtained by Messrs. Rosa, Dorsey, and Miller in a deter-

mination of the ampere in absolute measure at the Bureau of Standards. A current balance of the Rayleigh type was used, a coil being suspended from one pan of a balance so that it hung horizontally between two horizontal fixed coils of double its diameter, the three coils being coaxial. The change of weight in one pan of the balance necessary to maintain equilibrium when the current in the fixed coils was reversed was determined. The absolute value of the chemical equivalent of silver obtained by means of the balance is 1·11804 milligrams per coulomb. The value adopted at the London Conference in 1908 was 1·11800. The electromotive force of the Weston normal cell at 20° C., obtained by sending one absolute ampere through an international ohm, was found to be 1·01822 volts.

AT the recent Karlsruhe meeting of the Naturforscher-versammlung Prof. von Kowalski, of Freiburg (Switzerland), gave a summary of our present knowledge of the phosphorescence of organic substances at low temperatures, a knowledge which we owe largely to the observations made by him and his pupils. Many organic substances which exhibit no signs of phosphorescence at ordinary temperatures become phosphorescent in liquid air, and the intensity of the effect is increased if the substance is in solution in water or in alcohol to a concentration of about one-twentieth normal. Subjected to ultra-violet light for an instant, the solid solution gives a continuous phosphorescent spectrum, which gradually fades away, the longer waves disappearing first. If the exposure to the light is continued for a second or more the phosphorescent spectrum shows, in addition, a number of bright bands which persist longer than the continuous spectrum, and in fading away appear to spread themselves over the whole spectrum. These bands are intimately connected with the chemical structure and with the ordinary absorption spectrum of the substance investigated. Their positions can be obtained by displacing the absorption bands through a fixed interval towards the red end of the spectrum.

SEVERAL new models of microscopes, particularly the type known as the "Handle Model," are described in a catalogue received from Messrs. R. and J. Beck, Ltd. It is a matter of no small importance to the student to be able to lift his instrument without fear of straining any of its parts or of dislocating the objective in relation to the object. Many cheap microscopes are so designed that it is necessary when moving them to grasp the base; otherwise considerable strain is thrown on the fine adjustment. The models referred to are made in different patterns to suit either the student or the advanced worker, and in either case the price is moderate. The cheapest of the series is an example of what can be done in this country when modern methods of production are adopted. It is probably the least expensive microscope, for the adjustments provided, at present to be obtained of either English or Continental manufacture. The fine adjustment is of the lever type, so that the chance of it getting out of order or of becoming less accurate as the result of wear is reduced to a minimum. The stand is supported on a foot of the horseshoe type, and the objections to this design are to some extent obviated by lengthening the point of support towards the observer, with the result that increased stability is secured.

STUDENTS and teachers of applied mechanics in search of new examples as test exercises will find the set prepared by Mr. C. E. Inglis (Cambridge University Press, price 2s. 6d. net) to be of service. There are, in all, 100 exercises, divided into twenty papers; these are chiefly drawn from examination papers set at the Cambridge Engineering Laboratory, and the standard of most of the problems is that of the "A" papers in the Engineering Tripos examinations. Answers to the problems are included, but no hints for solution are given; hence the questions fulfil the purpose of the author, which is to provide material for the student who has learned many principles, but must also gain self-reliance in the application of the knowledge he has acquired. The problems given cover a wide range, and include exercises in structures, machines, strength of materials, and higher applied mechanics generally. The diagrams are well drawn and are clearly dimensioned. Many of the problems bear the stamp of novelty, and are suggestive of others on the same lines. Students preparing for the final engineering examinations of any of the universities should find the book useful.

Engineering for December 8 contains an account of a peat-gas plant which has been working at Portadown, in Ireland, since September last with results which are reported to be quite satisfactory. The plant works with air-dried peat, and consists of two producers of 200 brake-horse-power capacity each, together with coke-scrubber, tar-extractor, sawdust scrubber, exhauster, and expansion box. The peat is fed in block form into a hopper above the producer, whence it falls into the producer itself as combustion proceeds. The gas is drawn off through the coke-scrubber and washer to the tar-extractor, where the tar is extracted under centrifugal action. It then passes on to the sawdust scrubber, and is delivered to the gas-holder by a high-speed fan, which draws it through the plant. The heating value is about 140 British thermal units. This plant has replaced a Mond-gas plant by which power was formerly provided, and figures are given in comparison of the cost of the two methods of power-gas production. The net expense for fuel in the peat-gas plant is 4*l.* 5*s.* per week. The anthracite used in the Mond-gas plant cost 13*l.* 16*s.* 3*d.* per week. The plant has not been running sufficiently long to ascertain definitely whether a slight increase in labour may be necessary; but, allowing 40*l.* per annum for such a contingency, under these conditions at a factory of 500 looms, employing 500 to 600 hands, a saving in the fuel bill of about 438*l.* would result. The plant was constructed by Messrs. Crossley Brothers, Ltd., of Manchester.

A SECOND French edition of the first part of vol. i. of Prof. O. D. Chwolson's "Treatise on Physics" has been published by MM. A. Hermann et Fils, of Paris, at the price of 17 francs. As was the case with the first edition, the translation is the work of M. E. Davaux, and is based on the Russian and German editions. In this case, too, additions and notes have been made by MM. E. and F Cosserat. The previous edition was reviewed in the issue of NATURE for February 15, 1906 (vol. lxxiii., p. 362), to which reference may be made.

OUR ASTRONOMICAL COLUMN.

SCHAUMASSE'S COMET, 1911*h*.—From the Nice and the Arcetri observations of comet 1911*h*, on November 30, December 1 and 2, M. Fayet has calculated a set of elements, which is published in a supplement to No. 4541 of the *Astronomische Nachrichten*. The elements give February 5, 1912, as the date of perihelion passage, and, as will be seen from the extract from the ephemeris, given below, the comet is now getting nearer to both the earth and the sun.

Ephemeris 12*h.* (*M.T. Paris*).

1911		α (true)		δ (true)		log r		log Δ		$1/r^2\Delta^2$
		h. m.		° ′						
Dec. 12	...	13 55·6	...	+ 3 6	...	0·1611	...	0·2459	...	0·15
,, 16	...	14 11·2	...	+ 2 8	...	0·1506	...	0·2352	...	0·17
,, 18	...	14 27·2	...	+ 1 9	...	0·1403	...	0·2252	...	0·19
,, 22	...	14 35·4	...	+ 0 39						

The comet is travelling south-east through Virgo, and rises about three o'clock in the morning.

OBSERVATIONS OF COMETS.—In No. 4538 of the *Astronomische Nachrichten* Prof. Barnard publishes the results of his observations of Wolf's periodic comet (1911*a*) during the present return. The observations were made with the Yerkes 40-inch refractor, and show that the magnitude was about 14–15, the diameter from 5″ to 10″, and that the comet was a small and indefinite, although not diffused, object.

Positions of comet 1911*b* (Kiess), determined during July 13 to August 10 at Leipzig, are given by Dr. H. Naumann, who found the comet to be very diffuse and changeable in appearance.

In No. 4539 of the same journal Dr. Backlund discusses the observed and calculated places of Encke's comet (1911*d*) during the present apparition, with special reference to the question of acceleration and the mass of Mercury adopted in calculating the perturbing forces. Prof. Konkoly records the wave-lengths and intensities of the four bands 560, 546, 516, and 472 observed in Brooks's and Beljawsky's comets, showing that the second and fourth of these were relatively faint in Beljawsky's comet at the time of observation. Only the first, third, and fourth of these bands were recorded in the spectrum of Quénisset's comet on October 14.

In the *Gazette Astronomique* (Nos. 47–48) are reproduced drawings, made by M. Biesbroeck at Uccle, of comets 1911*c*, 1911*f*, and 1911*g* on October 17; the differences in form are very striking. That of Brooks's comet (1911*c*) is of the Morehouse type, with long envelopes developed in front of the nucleus sweeping out into a long, fairly narrow tail. The form of comet 1911*f* (Quénisset) is very different, the tail being emitted as a narrow straight jet from a point at the centre of the rear of the head. In Beljawsky's (1911*g*) we recognise the type of envelope seen in the case of comet 1910*a*, where the nucleus was located slightly within the front surface of a broad parabolic envelope.

THE DISTRIBUTION OF STARS OF DIFFERENT SPECTRAL TYPES.—Dr. Karl-Gustav Hagström publishes the results of an interesting investigation concerning the distribution of stars in space, from the point of view of their spectra, in No. 7, vol. xlvi., of the *Kungl. Svenska Vetenskaps-akademiens Handlingar*. He finds that his class α (fifth-type stars) shows a marked concentration about the equator of the Milky Way, and that his β type (Orion stars) are more numerous and more concentrated in the southern than in the northern hemisphere; but for solar and first-type stars, also for the later types, he can find no preferential grouping. Accepting Herschel's idea that the visible stars form a single system, and admitting that the non-concentrated types are inside the ring of such a system, it would appear from this investigation that the system is lenticular in form, the cooler redder stars being situated in the neighbourhood of the sun, and the hotter stars in the edge of the lens form. As the hotter stars also appear to be in the southern hemisphere, it would seem that the sun is located in the northern part of this stellar system.

DETERMINATION OF RADIAL VELOCITIES.—An important contribution to the study of stellar radial velocities appears in vol. x. of the Annals of the Cape Observatory—Spectroscopic Researches. It contains the results of the measurement and discussion of radial-velocity plates taken between November 7, 1903, and May 4, 1908, and deals with thirty-one stars of the third magnitude and brighter. The measurements of each line on each plate, and the wave-lengths of the comparison spectra, are very fully discussed, and it is shown that there is apparently a distinct variation of wave-length with spectral type, the thirty-one stars, for this purpose, being arranged in six successive groups. A comparison of the Cape results with those published, for the same stars, by other observatories is reassuring concerning the general trustworthiness of radial-velocity results; thus eleven out of the thirteen results given for α Tauri, determined at six different observatories, all lie between 51·7 and 55·9 km. per sec.

EARLY METHODS OF DETERMINING LATITUDE.—Among the publications of the Deutsche Seewarte of the Kaiserliche Marine at Hamburg has recently appeared a memoir entitled "Die Geschichtliche Entwicklung der Polhohen-bestimmungen bei den älteren Völkern," by Carl Schoy. It contains a history of the various methods of determining geographical latitude employed by the early astronomers to about the date 1250. The author makes no original contribution to our sources of knowledge; but he has made a careful survey of the existing sources and the work of modern scholars, and his explanatory comment, with numerous references, should be useful to those who are interested in the archæological side of the subject.

The memoir consists of five chapters, of which the first deals briefly with the earliest attempts at a solution of the problem, especially among the Chinese. The second chapter relates to the Greek astronomers, from Eudoxus to Ptolemy; in this period we find the earliest recognition of the change of latitude with locality. The contribution of Indian astronomers, which is next described, does not seem to have advanced the methods of observation, but was of the greatest importance in the development of trigonometry.

The last two chapters treat of the work of the Arab astronomers Al-Battâni, Ibn Jûnis, and Abul Hassan, of Morocco. The mediæval Arabs inherited the knowledge acquired by the Greeks and the Hindus, and are known to have possessed translations of the works of Euclid, Ptolemy, and Brahmagupta. But they also made notable progress on their own account. Abul Hassan, in particular, shows the greatest fertility of resource in inventing new methods, and succeeded in solving the most complicated problems in dialling. This, at least, would appear from his work; but, naturally, it is impossible to estimate the debt which he owed to his predecessors.

STARS HAVING PECULIAR SPECTRA.—While examining the photographs of the Henry Draper Memorial, the late Mrs. Fleming discovered an immense number of variable stars and other objects having peculiar spectra, and the finds have been from time to time recorded in the Harvard College Observatory Circulars. No. 167 of these probably completes the record of Mrs. Fleming's discoveries, and contains a list of thirty-one new variables, of which thirteen were found by her. It also gives a list of seven stars having peculiar spectra, of which Mrs. Fleming discovered five; in three cases $H\beta$ is bright, three others contain bright lines, one being a gaseous nebula, and the other has a normal fourth-type spectrum.

THE EVOLUTION OF MULTIPLE STARS.—The question of the evolution of double and multiple star systems is discussed, in the light of recent discoveries, by Dr. See in No. 4539 of the *Astronomische Nachrichten*. *Inter alia*, he states that such systems, having developed from spiral nebulæ of vast extent and slow motion of revolution, should show but little relative motion, and suggests that in such cases as β Cygni, α Tauri, &c., an effort be made to photograph the extremely faint residual nebulosity which, according to the hypothesis, may still surround the members of such systems.

MATHEMATICS IN ENGLISH SCHOOLS.

THE powerful and vigorous article on "Mathematics in English Schools" contributed to *Science Progress* for October by Mr. Charles Godfrey, headmaster of the Royal Naval College, Osborne, opens up a subject deserving the most attentive study on the part of everyone who is interested in the future progress of our race. As the author points out, modern civilisation stands on a foundation of applied mathematics; without mathematics the earth could not support its present population. But in England we have a ruling class whose interests are sporting, athletic, and literary; consequently not only is mathematics not a bread-and-butter subject except for those who are satisfied with this simple diet, but the work of the mathematician is ignored and even treated with contempt. And this in spite of the fact stated by Mr. Godfrey, that mathematics occupies a larger share of time in our school curricula than in those of other countries. The remedy proposed by Mr. Godfrey is that our teaching in schools should be based on the "outlook" value of mathematics, and should train our boys to appreciate the tremendous potentialities of the subject of which they are mastering the elements. At

present our teaching involves a large amount of disciplinary drill in subjects like algebra, which affords no outlook beyond that afforded by the examination value of the subject.

Mr. Godfrey finds that, whatever may be the real educational value of this training, we have no definite proof that it confers advantages which could not be at least equally efficiently derived from other studies. On the other hand, we have certainly failed in one thing: broadly speaking, we have failed to make mathematical thought enter as a main element into the life of the educated classes. More and more the affairs of life are being made amenable to mathematical treatment, and as it has turned out the development has been on lines divergent from the lines of schoolwork. In these developments, the study of the calculus has been the fundamental form in which mathematics is applied to the affairs of modern life. This study, however, does not grow out of the summit of school mathematics, but branches off low down the stem, and it is independent of formal geometry; a vigorous pruning of school algebra and arithmetic would in no wise prejudice the growth we want to encourage.

Mr. Godfrey, referring to the requirements of the non-mathematical schoolboy, compares the drudgery and drill of multiplying and dividing long algebraic expressions to the technique of piano-playing, which may be useful for the professional musician, but conspicuously fails to stimulate a taste for music in the average pupil. He finds that the time saved from this drill would amply suffice not only for the teaching of the calculus when its fundamental principles are divested of the unnecessary complications introduced by the consideration of transcendental functions, but that a stimulating course in mechanics can quite well be fitted into the curriculum which the mathematical as distinct from the science master can provide for the non-specialist schoolboy.

As regards statics the position is clear, provided that experimental methods receive due prominence. The case for dynamics is not so clear, and Mr. Godfrey's difficulties may perhaps receive confirmation from the disagreement which still exists among teachers regarding mass and weight, poundals and slugs. He would therefore propose to restrict the study to kinematics, which, as he points out, is really nothing more than geometry with the introduction of a time element. Many of Mr. Godfrey's suggestions have been under the consideration of the committees appointed by the Mathematical Association to inquire into the teaching of school mathematics, and the feasibility of the proposals to which he directs attention is proved by the fact that, in the French *lycées* for classical specialists, the proposed training in analysis is reached with a far shorter number of hours of schoolwork than is given to mathematics in England.

The views indicated very imperfectly in this abstract will doubtless be read with regret by disciples of the old school. But England's neglect of mathematics requires us to face many hard and unpleasant truths, and it is probably no exaggeration to say that at the present time a plea for the study of classics, even Latin and Greek grammar, would receive a favourable reception at the hands of a large section of the British public which would turn a deaf ear to any corresponding claim of the mathematician.

G. H. B.

THE HEALTH OF THE NATION.

THE sixth annual meeting of the National League for Physical Education and Improvement was held at the Mansion House on December 8, the Lord Mayor presiding. Letters of regret were read from the Archbishop of York, Lord Haldane, the Lord Chief Justice, and others. The first speaker was Sir Archibald Geikie, president of the Royal Society. He greatly approved of the objects of the league, which are to stimulate public interest in the physical improvement of the people, to lessen waste by coordinating agencies already established for this purpose, and starting them where none at present exist, to make better known the local powers already possessed by public authorities, and to promote fresh legislation where necessary. In a short, telling speech he pointed out that while the league was to be congratulated on the very rapid and excellent progress it had made during the six years in which it has been in existence, it has been, and still is, hampered by want of funds, a want which it is to be hoped will be remedied in the coming year by the aid of all those who have the health of the nation at heart.

Bishop Boyd Carpenter described more in detail the work of the league during the past year. The three subjects on which it had been particularly engaged were the need for a clean milk supply, organised physical recreation, and the dangers arising from the use of inflammable makes of flannelette. He showed that the league's work was not of a purely philanthropic nature—it was an effort at self-protection on the part of a great nation. It tried to protect children in their upgrowth and to prevent them, in various ways, from becoming a source of weakness to the community.

Prof. Bostock Hill, medical officer of health for Warwickshire, suggested that a national health week be instituted, culminating in a Health Sunday, when the churches might bring home to the nation the gospel of hygiene. Communal sanitation has resulted in a very considerable reduction in the death-rate of this country; but he pointed out that more than communal effort was now required, and that this could only be brought about by giving to the people individually a knowledge of what hygiene could do for them, and at the same time co-ordinating the services of all societies, private and public, towards this end. People must be brought to understand that hygiene consists in the spread of cleanliness, applied to air, food, earth, and the dwelling.

Lady St. Davids brought forward several practical suggestions, such as the formation of tooth clubs for toothless people, instead of boot clubs for bootless children, since the former were in more danger of injuring their constitution than the latter. She also pleaded for the closer cooperation of the nursing profession with all who were concerned in the promotion of the health of the nation.

THE ANALYSIS OF SPECIES.[1]

THE author of the paper referred to below has made an important pioneer contribution to the study of heredity in crosses between plants of widely divergent phylogeny, viz. reputed species of Linum, and has compared the results obtained from such species-hybrids with those obtained from the simpler varietal crosses. Statistical methods have been utilised for the expression of the characters examined, as in the work of Johanssen.

The general trend of the results is to show that even in cases where the composition of F_2 appears to present perfectly smooth variation between the two parental extremes, the behaviour in F_3 shows that the inheritance is in reality factorial, and can be most easily explained on Mendelian principles. The frequency with which the parental forms reappear is least in crosses of reputed species, and becomes more common with closer crosses until simple mono-hybrids are reached. The methods by which the data were obtained appear to have been above suspicion, both experimentally and statistically, while the important error from vicinism is said to have been excluded.

One possibility has perhaps been overlooked, namely. that while the inheritance of such a character as length of seed is probably determined by several allelomorphic pairs, yet the ultimate dimensions of the seed of any given plant, fluctuation having been evaluated, may be influenced through correlation with other similarly inherited characters, notably the dimensions of the fruit. The position of any plant in the frequency curve for a family is thus, apart from fluctuation, firstly determined by the factors which it carries, and secondarily by a deflection of the expression of those factors from the normal by somatic correlation.

The characters studied were the length and breadth of the seed, the length and breadth of the petals, and the

1 "Das Verhalten fluktuierend variiender Merkmale bei der Bastardierung." Von Tine Tammes, aus dem Botanischen Laboratorium der Universität Groningen. Extrait du Recueil des Travaux botaniques Néerlandais, vol. viii., Livr. 3, 1911.

petal colour, all of which received quantitative measurement, together with qualitative studies of the dehiscence of the fruit and the hairiness of the ovary walls. The article is illustrated by two photographs, and by ten diagrams which include nearly a hundred frequency polygons.

W. L. B.

AMPHIBIAN FAUNAS OF SOUTH AFRICA AND MADAGASCAR.

IN discussing the relationships between the amphibian faunas of South Africa and Madagascar in the Annals of the Transvaal Museum for April, Mr. J. Hewitt accepts the theory of an early land connection between Australia, India, Madagascar, the Seychelles, and South Africa, which was sundered between Australia and Africa after the Lower Cretaceous, and was elsewhere broken up into islands in the early Tertiary. The connection between Madagascar and India persisted until the Eocene, or perhaps later, as an archipelago, and Africa may have been connected by swamps with Madagascar until the early Pliocene. Another land-bridge connecting South Africa and South America by way of the Atlantic is likewise accepted. The fauna of the whole area is considered to have had many features in common; but after the separation of Madagascar and the formation of the African continent the latter area was invaded by a Palæarctic fauna, which could not reach Madagascar. The fauna of that island accordingly seems to represent in a modernised form—with a few additions—the one originally common to the southern Ethiopian area.

The author then proceeds to discuss how the relations of the amphibian faunas of Africa, Madagascar, South America, and Australia can be explained on these suppositions. To follow him in detail would take too much space; but it may be mentioned that he is disinclined to accept the generic identity of the Malagasy boa-like snakes with South American types, and that he regards true frogs (Rana) as of African, and tree-frogs (Hylidæ) as of South American, origin. The two latter are stated to have attained their present distribution by crossing what is now Bering Strait, in opposite directions, after the sundering of the connection between Africa and South America (p. 37), Rana having thus reached South America from the north (p. 35). On the other hand, it is stated later (p. 38) that the Ranidæ are an Old World group "which crossed over to the Neotropical region at a time when the land-bridge was just beginning to give way, and when eventually they had travelled northwards as far as the Antillean bridge this was no longer complete." The discrepancy in the two statements requires explanation.

WATER SUPPLY IN AUSTRALIA.

THE great drawback to settlement in some parts of Australia is the frequent droughts that have to be dealt with. So far back as 1884 the New South Wales Government appointed a commission to consider the question of irrigation, and, as a result, a water conservation department was organised, and an experienced Indian irrigation engineer appointed to advise. As one result of this the construction of a dam across the Murrumbidgee River was decided on. This dam, known as the Burrinjack Dam, rivals in size and quantity of water impounded the famous Assouan Barrage across the Nile. The Murrumbidgee River for 200 miles above the dam runs its course principally amongst mountains, the higher peaks of which are covered with snow in winter. The catchment area at this point amounts to 5000 square miles, the rainfall varying from 20 to 70 inches a year. At the place where the dam has been constructed the whole of the river water passes through a narrow granite gorge, and consequently the minimum cost of construction, combined with the maximum stability, has been secured. For about 200 miles below the dam no irrigation works are needed, as the district through which the river flows is undulating and has a sufficient rainfall. Below this the river enters a flat country, with a diminished flow of water. Like some other rivers in Australia, the Murrumbidgee, instead of increasing in volume as it proceeds on its downward course to the ocean, actually diminishes, and becomes a small stream. This is due to the diversion of its water into shallow lagoons, where the evaporation caused by the fierce sun and percolation disposes of the greater part of the water. The dam is of concrete, 240 feet high and 784 feet long. It will back up the water in the main stream for 41 miles, and of two of its tributaries for 15 and 25 miles. Although the water supply is to be brought into operation at once, the dam has only been built up to 110 feet; the remaining 130 feet, it is expected, will take two years more to complete. For carrying on the works and providing for the staff employed a temporary township has been created provided with complete sanitary arrangements and medical attendance. An electric installation has also been set up for working the cranes and other machinery. A light railway 28 miles long has been constructed connecting the temporary township with the main line of railway from Sydney to Melbourne. The estimated cost of this work is 758,000*l*.

THE DIVINING ROD.

DR. L. WEBER, professor of physics in the University of Kiel, has published in the *Journal fur Gasbeleuchtung und Verwandte Beleuchtungsarten sowie fur Wasserversorgung* a copy of an address on the divining rod read by him at Flensburg in September last. Dr. Weber regards belief in the powers of water diviners as a form of antiquated superstition and gross error; he is of opinion that there is no evidence that the movements of the rod are due to any cause outside the diviner, who is the subject of self-deception. He bases this view on the results of careful investigation, but, in so far as the paper in question is concerned, only one instance of actual experiment is given (see below).

Dr. Weber mentions the results obtained by Herr von Uslar in the German African colonies, and thinks that the divining rod was, in this case, simply a magic staff which animated von Uslar's expedition to extraordinary exertions, and, more particularly, to deep boring with excellent results.

The experiment mentioned in the *Journal* is one performed at Flensburg before the Association of Gas and Water Specialists of Lower Saxony. Herr Léon, a well-known water diviner from Kiel, submitted himself to the blindfold test tried so frequently; he indicated two places in a room, in one of which his rod acted strongly, and in the other of which there was little or no action. He was then carefully blindfolded, turned round, and taken to the two places in irregular turns, when his rod gave corresponding indications to those obtained at first (when not blindfolded) in only two cases out of the six. The present writer has performed similar experiments, and always with similar results to those which Dr. Weber obtained with Herr Léon: he is, however, of opinion that they cannot be regarded as conclusive, since it is quite possible that, if the movements of the diviner's rod are due to an objective cause, the blindfolding may influence the nervous condition of the water diviner in such a way as to render him a less efficient "water indicator" than he would be in ordinary circumstances. On the other hand, it must be remembered that Herr Léon accepted the conditions of the experiment, and when a scientific man undertakes to investigate an apparently mystic process, such as water finding, he cannot be expected to do more than lay down conditions which appear to him reasonable and are accepted by the diviner.

J. W.

NEW MECHANICAL ENGINEERING LABORATORY OF THE MUNICIPAL TECHNICAL INSTITUTE, BELFAST.

ABOUT eighteen months ago the Corporation of Belfast authorised the preparation of plans and the installation of a teaching equipment suitable for the scientific training of mechanical engineers. The plans for this work were at once put in hand, and the installation has been carried out to the designs and under the direction and superintendence of Prof. J. H. Smith, head of the mechanical engineering department of the institute.

The laboratory was opened by Prof. J. Perry, F.R.S., on November 24 in the presence of a large company, including members of the Corporation, prominent manufacturers, and business men. The dimensions of the laboratory are 141 feet by 42 feet, with a mean height of 20 feet. The building is fitted with two travelling cranes. It has an upper floor and a lower floor, between which are placed the lines of shafting, the piping for engines, and all similar accessories.

The installation includes steam-driven machines, electric generating plant, oil engine, gas engine, petrol engine, centrifugal pumps, turbines, and refrigerating machine. There is also a full range of smaller testing appliances necessary for the complete training of an engineer.

The detailed list of appliances is a very lengthy one. The steam generating section includes a Lancashire boiler measuring 30 feet by 8 feet, and a marine-type boiler measuring 14 feet by 11 feet, together with pumps, meters, economiser, superheater, feed-water heater, induced draught fan, pressure and temperature indicators, &c.

The steam section comprises a steam engine of the horizontal cross-compound type of 60 horse-power, built by Messrs. Combe Barbour, of Belfast; a 20 horse-power high-speed generating set built by Messrs. W. H. Allen and Co., of Bedford; a 15 kilowatt Parsons steam turbo-alternator; a De Laval turbine of 20 horse-power; a steam pump and a condensing plant.

The hydraulic section is exceptionally well designed and equipped, and includes a motor-driven high-lift turbo-pump, cast-iron channels, tank, tumbling bay, venturi meter, pitot tubes, Thomson turbine, Girard turbine, Pelton turbine, and an apparatus for experiments on pipe friction.

The testing of materials section contains a Richlé testing machine of 68 tons capacity, on which experiments may be made in tension, compression, bending, and torsion; an Adie machine for cement testing; a fatigue testing machine, designed by the professor of mechanical engineering (Dr. Smith); appliances for the microscopical examination of metals; a "hardness of metals" tester; and various other appliances.

The section of internal-combustion machines includes a gas engine, a suction-gas plant, an oil engine, and a petrol engine. Additional fittings are a main switchboard of special design, an air-compression plant, a refrigerating plant, and an electrical direct-driven fan of "Sirocco" pattern. There are, in addition, all the necessary subsidiary appliances, such as calorimeters, micrometer, and other gauges, indicators, anemometer, &c.

The workshop adjoining the mechanical engineering laboratory is exceptionally well fitted with up-to-date machines, amongst which are a universal milling machine, a high-speed planer, a high-speed screw-cutting lathe, a boring and surfacing lathe, a Hendy-Norton screw-cutting lathe, a vertical automatic drilling machine, a shaping machine, together with grinding machines, brazing apparatus, vices, and other adjuncts found in a well-equipped machine shop. Adjoining the machine shop is a pattern shop, which contains a hand-turning lathe, circular saw, band saw, universal wood-cutter, and the requisite supply of benches.

The Plenum ventilating and heating plant also forms part of the mechanical engineering equipment of the institute, and from time to time it is used in the instruction of students and for experimental purposes.

Photo.] New Mechanical Laboratory, Municipal Technical Institute, Belfast. [*A. R. Hogg.*

The city of Belfast can now claim to possess a mechanical engineering equipment as comprehensive as that of any technical institution of the United Kingdom.

SCIENCE EXAMINATIONS AND GROUPED COURSE CERTIFICATES.[1]

CIRCULAR 776 was issued by the Board of Education on June 20, 1911, which date was near the commencement of the long vacation, and made it practically impossible for the governing authorities of technical institutions to introduce any necessary amendments into the schemes of instruction for the present session. In its general arrangements the scheme is, without doubt, excellent, and teachers familiar with certain of the local group course systems will probably at first conclude that it will fit the modern conditions of the group course system very accurately. More careful study, however, reveals the fact that there

[1] From an address delivered before the Association of Teachers in Technical Institutions on November 11 by Mr. Barker North, ex-president of the Association.

are enormous difficulties in the way of its immediate adoption, and the smaller technical institutions in particular will be very hard hit by the condition bringing the scheme into operation during the present session. These difficulties exist with reference to both day and evening work, but it is in connection with the latter that the matter is one of great urgency, and the following remarks will therefore deal only with the principal changes affecting evening instruction.

A. *Changes in Subjects and Stages foreshadowed in the Circular.*—(1) The abolition of all Stage I. and practical examinations; (2) the abandonment of all examinations held by the Board in the following subjects: sound, light, geology, mineralogy, physiology, general biology, zoology, botany, navigation, nautical astronomy, physiography, agricultural science, hygiene, and elementary science of common life; (3) principles of mining becomes coal-mining only; (4) for the purpose of constituting examining boards, to include teachers in technical schools, the subjects retained will be grouped as follows: (*a*) pure and applied mathematics, (*b*) engineering, (*c*) physics, (*d*) chemistry, (*e*) mining and metallurgy; (5) there will be two stages only in each subject, viz. "lower," corresponding to the old Stage II. examinations, and "higher," the standard being intermediate between the old Stage III. and honours examinations; (6) in each grade of each subject, one paper only will be set, with the exception of "higher" pure mathematics, in which two papers will be given.

B. *Conditions of Admission.*—(1) A fee of 3*s*. 6*d*. must be paid by the candidate for each stage in each subject; (2) candidates must be over seventeen years of age on July 31 following the examination; (3) students taking full-time *day* courses will only be admitted under special conditions; (4) in the following subjects: theoretical mechanics (solids), theoretical mechanics (fluids), applied mechanics (materials and structures), applied mechanics (machines and hydraulics), heat engines, heat, magnetism and electricity, inorganic chemistry, organic chemistry, and metallurgy, a candidate for admission to the higher examination must furnish a certificate of having completed a satisfactory amount of laboratory work, and submit laboratory note-books signed and certified by the teacher.

C. *Records of Successes.*—The issue of personal certificates will be discontinued, result lists only being published by the Board, with the following exceptions: (1) certificates for the present will be issued for coal-mining; (2) personal certificates to successful candidates at *higher examinations only*, will be awarded provided (*a*) "that they have previously received appropriate group course certificates" endorsed by the Board, (*b*) "that the examination has not been approved in connection with the course for a certificate"; (3) successes in higher and lower stages, and in other approved external examinations, such as the City and Guilds Institute, may be recorded upon grouped course certificates endorsed by the Board, but successes at internal examinations may not be separately recorded.

After studying the conditions detailed above, most teachers will no doubt come to the conclusion that evening students will not be likely to sit for the Board's new examinations. The institution of the 3*s*. 6*d*. fee will alone act as a sufficient deterrent, especially in the case of a group course student wishing to take several examinations, but this, when combined with the fact that a record of success can only be obtained by complying with certain very difficult conditions, must reduce the number of candidates almost to the vanishing point. The past few years has been a transitional period, and elaborate group courses, suited to the local industries, have been adopted by most schools in place of the system of detached classes suited to the Board's examinations. In most places, however, the syllabuses of instruction are modelled on the syllabuses of the Board's science examinations, no doubt with the view of attracting certain students who still place faith in the certificates awarded by the Board; and this is the case particularly with smaller institutions, where the local certificates have proved so far of little value. This must continue until some means can be devised of giving a definite and fairly uniform value to the certificates awarded by different institutions for corresponding years of a group course.

Undoubtedly the country is ripe for the introduction of a national group course system, and we therefore turn expectantly to the scheme which the Board suggests.

The Scheme of Grouped Courses in the Circular.—For evening students the Board suggests the classification of courses into three grades:—(1) Junior courses (two years), for youths leaving elementary schools at fourteen. (2) Senior courses (three years), for students who have taken either (*a*) a junior course, or (*b*) a three years' course at a secondary or higher elementary school. (3) Advanced courses (two years), for students who have taken the senior course. The Board is prepared to endorse certificates in senior and advanced courses only under the following conditions, amongst others:—(1) The group course system *must previously have been approved* by the Board, who must also be satisfied with the equipment of the school, and the steps taken to admit only properly qualified students to the course. (2) No unendorsed certificates may be issued by the local authority.

The local certificates of a few of the larger institutions in the country have already become of some value to the holders in the local industries, and therefore the question of endorsement is of little immediate importance to these places, but in the case of the smaller institutions, in view of the fact that the local certificates are not of great value, if any, where they are already given, the question of endorsement becomes of prime importance. A cursory glance at calendars of various technical institutions will show that, although each may have many excellent features, such a variety exists in the construction of the courses that the Board cannot conscientiously approve many of these, and thus a grave injustice must be done during the next few years to a great number of students who have been working towards a definite objective. Take the first three years' courses at Manchester, Bradford, Leeds, and Liverpool in chemical industries as examples. The total possible student hours in the three years are, respectively, Manchester, 660 hours; Bradford, 540 hours; Leeds, 697 hours; Liverpool, 630 hours; sufficient variation, one would think, to result in a very different standard of attainment at the end of the Board's senior course scheme, each institution admitting at the age of sixteen years. The division of the time mentioned above is apportioned as follows:—

—	Manchester	Bradford	Leeds	Liverpool
	hours	hours	hours	hours
Theoretical Inorganic Chemistry	60	90	97½	90
Practical " "	165	150	180	135
Theoretical Organic Chemistry..	60	60	75	nil
Practical " "	240	60	90	"
Preliminary Mathematics	60	nil	nil	60
Theoretical Elementary Physics	30	"	37½	30
Practical " "	45	"	37½	45
Principles of Analysis...	nil	45	35	nil
Chemical Calculations	"	15	60	"
Tutorial Work	"	30	nil	"
Theoretical Heat (Stage II.) ...	"	30	"	30 (or Electricity)
Practical " " ...	"	60	"	45
Pure Mathematics, Stage II., or Theoretical Mechanics, Stage I.	"	nil	"	120
Theoretical Electricity, Stage I. or II.	"	"	"	30
Practical Electricity, Stage I. or II.	"	"	"	45
Technical Analysis	"	"	90	nil

It should be mentioned that at Bradford the student takes preliminary mathematics, elementary physics, and Stage I. inorganic chemistry for two years in the branch technical schools as a preliminary, whereas the other institutions all begin with Stage I. inorganic chemistry in the technical courses mentioned above. Further, in the three years' course above, Bradford completes Stage III. inorganic chemistry, the other institutions completing Stage II.; in organic chemistry, Manchester and Leeds complete Stage II. work, Bradford Stage I., and Liverpool does not include organic chemistry in the three years' course.

An examination of some 200 calendars of institutions throughout the country has shown that the examples given

are typical of the group course system, a feature which is not surprising when we consider the way in which the course system has developed. It illustrates, perhaps, more clearly than any other fact the lack of "guidance from the mind that sees the needs of the country from the greater and national point of view." Cast-iron schemes and syllabuses are not required: the Board's rigid syllabuses have during recent years proved a failure from the teacher's point of view; but surely some greater degree of uniformity can be obtained than is shown above, whilst retaining the necessary pliability to suit local requirements of the industries. Before any uniform system of endorsement of certificates can be introduced, coordination of the courses in different institutions must be secured by the standardisation of the courses, as a guide to the standard to be arrived at in any one year, or at the end of a given course. A very grave injustice will be done to a great number of students, and, further, there will be a danger of the loss of many students, unless the conditions outlined in the circular are modified, either (1) by delay in the operation of the scheme for one or two years, or (2) by modifications of the conditions, such as reduction of the entrance fee, the granting of certificates by the Board, particularly in the lower stage, and the revival of examinations in such subjects as light and natural sciences, during the transitional period that must ensue until institutions can come into line with the new requirements.

The time is opportune, too, for revision of the award of Government grant on the work done by evening students. Local authorities are sufficiently hard pressed at the present time without taking over the burden of the cost of examination systems, and the time has arrived for allocating an increased amount of money in the form of a capitation grant for those taking group courses, somewhat on the lines of the grant made at present for day courses in technical institutions, thus differentiating between group courses and single-subject courses. Teachers are convinced that three nights per week, under present conditions of daily employment, are too much in the cases of youths under eighteen, and up to the end of the second year in the senior course the Board might reasonably make the full grant for two evenings (five hours) per week, extending over a thirty weeks' session, instead of encouraging, as at present, courses which are overburdened, for the local authority cannot afford to reduce the number of hours per week in the institution expected from the student, owing to the loss of grant which this would entail. A better grounding in the elementary branches of the work would at the same time undoubtedly be secured.

As to the best method of carrying out a national system of examinations, which is absolutely independent of centralised examinations such as those of the Board of Education, and City and Guilds Institute, the feeling is growing in some quarters that this will be most successfully accomplished by the cooperation of county education authorities with the local education authorities in county boroughs, to form examination boards of teachers and representatives of the local industries, acting as external examiners or assessors in conjunction with the teachers in the institutions of a given area as internal examiners. Such boards would be more in sympathy with the local requirements than any central board could possibly be, and the Board of Education, through its inspectorate, and a National Examination Board should be able to maintain a moderately constant standard throughout the country once the system is in thorough working order. Such a National Examination Board should contain representatives, who should be teachers, from the local examination boards.

Each year in a student's work marks a distinct stage in his career, and this should be recognised on successful completion of the work of each year by the award of a local certificate or record, to be exchanged at the end of the course for the full endorsed certificate, giving a national stamp, or hall-mark, to the work. At the same time, it is worth consideration whether certain single-subject courses of a highly technical character are not worth the award of a special endorsed certificate, particularly in cases where the student is able to take up the higher work without passing through the preliminary grind of the earlier years, or in cases where the subject-matter does not readily adapt itself to inclusion in a course. There is undoubtedly the need for a national evening course system, so that the smaller institutions may readily and naturally feed the larger, in which the more advanced work will be concentrated, and so that this work may lead up systematically to the day diploma work of our specialised technical institutions.

INDUCED ACTION OF LEUCOCYTES.[1]

SCIENTIFIC workers may like to have a brief account of some recent researches which, I think, are likely to be of both theoretical and practical interest. The researches commenced nearly five years ago in a special study of leucocytes by a method devised by my brother, Mr. H. C. Ross, and myself. This consists in placing liquid blood under a cover-glass, not, as usual, upon another surface of glass, but upon a bed of transparent jelly with which various reagents, including stains, have been mixed. The original object of the method was to try to cultivate human leucocytes *in vitro*. At first careful studies of the rate of absorption of stains by the leucocytes under various chemical conditions of the jelly were made by Mr. Ross. Two years later he found that extract of hæmal gland, extracts of apparently many dead and decomposing tissues, and globin, when mixed with the jelly, force a large proportion of the leucocytes to divide before the eyes. Subsequently, he and his assistant, Dr. J. W. Cropper, ascertained by a series of lengthy studies that many of the substances which possess this property (in different degrees) belong to the amidine grouping. They have found, also, that a second series of substances, though by themselves they cannot produce division of leucocytes, have the power of augmenting very greatly the power of the former group of substances to do so. They give the names *auxetics* and *augmentors* to the two groups respectively. The principal auxetics are extracts of organs, creatine, xanthine, creatinine, guanidine, benzamidine, theobromine, acetamidine, caffeine, theophylline, methylamine, ethylamine, propylamine, &c., and certain aniline dyes. Some of the augmentors are various alkaloids, atropine, choline, cadaverine, neurine, &c.

The technique, though simple, requires considerable care. If a stain such as polychrome methylene blue is added, the cells become coloured progressively as the division advances. All the varieties of the human leucocytes can be made to divide; but the technique is slightly different for each variety. The proportion of cells affected in a given preparation of blood varies according to perfection of technique up to, say, 80 per cent.; but as death occurs rapidly, especially if stain be used, it usually overtakes a large proportion of them before the division has been completed. After about twenty minutes all the cells die, and by that time the process is complete in only a small percentage. Efforts to keep the cells alive longer upon these medicated jellies or in solutions of auxetics have not yet been very successful and would not be easy. After their death the leucocytes give up again most of their stain, and the jelly preparation rapidly spoils; but a method has been found of making (with some difficulty) permanent specimens of such of the blood as adheres to the cover-glass by fixing the whole preparation with osmic acid vapour, and then freezing and picking off the cover-glass from the bed of jelly.

To watch the same cell passing through the whole process requires an accurately adjusted warm stage or microscope-incubator and considerable patience, because the cell which we happen to select for observation will most probably belong to the majority which die before completion of the division; but partial division can be easily witnessed. If, however, the specimen is incubated for ten minutes, and is then surveyed rapidly from field to field, numbers of the leucocytes caught in all stages of the process can be readily seen. The fixed films just referred to show exactly the same objects, but enable us to examine them repeatedly and at leisure. And in both these cases the dividing forms are so numerous and similar that there

[1] From a paper read at the meeting of the Pathological Section of the Royal Society of Medicine on November 7 by Sir Ronald Ross, K.C.B., F.R.S.

can be no question of their being exceptional artefacts or distortions, such as may sometimes simulate almost anything. Division of the mononuclear variety of leucocytes is produced and studied the most easily.

In films in my possession numerous examples of dividing mononuclears fixed at all stages demonstrate (together with observations of the jelly preparations) the following steps in the process. In a few minutes after the blood is drawn from the subject and mounted the round, so-called nucleus becomes oval and then kidney- or bean-shaped, leading on rapidly to the outline of two circles cutting each other, and, lastly, touching each other in a "figure of eight." When the process is about half complete, and if the direction of division is parallel to the surface of the jelly or glass, another phenomenon is seen. About four to eight finger-like processes, radiating from the point midway between the centres of the two circles, are protruded or divided off, giving the whole body roughly the appearance of an ant, of which the head and abdomen are simulated by the two spheres and the legs by the processes just mentioned. Such forms are numerous and characteristic; but, of course, when the direction of division happens to lie at an angle to the surface, they are foreshortened, or may be distorted by the pressure of the jelly. As the division proceeds the processes are retracted into each daughter sphere, until the final figure of eight is produced.

If polychrome methylene blue is put in the jelly the cells become coloured progressively as the division advances. At first, after a few minutes, the so-called cytoplasmic, or Altmann's, granules take a purple tinge; then the so-called nucleus becomes a pale blue, and last of all the so-called nucleolus is stained, after which, apparently, the cell dies. As the so-called nucleus proceeds to take the hour-glass and figure-of-eight forms, strands of coloured substance are seen, especially in the fixed films, passing between the two daughter spheres, and such connections are maintained until complete dissociation occurs. The behaviour of the so-called nucleolus is not easy to follow, because, as just noted, it does not stain until the cell dies and further division is checked. On the other hand, the behaviour of the so-called cytoplasmic granules must be described as very curious. In the middle of the division they are found to number about eight (when they can be easily counted) and to lie, each one, at the end of one of the finger-like processes mentioned above; and appearances suggest that half of each granule is distributed to one daughter cell and the other half to the other daughter cell. No distinct chromosomes are seen at any stage *inside* the so-called nucleus; and there appears to be no sign of astral fibres, though perhaps the finger-like processes may be interpreted as being bunches of these fibres which have not been rendered individually visible by the process of staining employed. On conclusion of the process the so-called cytoplasmic granules appear to be equally distributed between the two daughter cells, and to place themselves on the outer surface of the so-called nucleus of each, that is, in the position in which they were seen in the original parent cell. Apparently asymmetric forms are also frequently seen, but need not be described here.

Such seem to me to be the facts as observed by myself in preparations shown or given to me by Mr. Ross and Dr. Cropper. I will not touch here upon the similar divisions of the so-called polymorphonuclear leucocytes, which have also been already described and figured by Mr. Ross. Nor will I attempt to reconcile the observations with current cytological teaching, even as regards the division of leucocytes. Very probably different methods of staining may bring them, at least partly, into closer conformity. Though engaged for years in the study of blood I have never seen these forms before, nor, indeed, have I ever seen in any ordinary preparation what could certainly be called a dividing leucocyte. I have been shown bodies claimed to be such; but these are admittedly so rare that they are open to the usual logical fallacies connected with very exceptional observations. The observations here referred to are not open to these fallacies. As I have said, the dividing forms are so numerous and characteristic that we can have no doubt that they really are dividing forms—whatever other observations or theories may be on record. It seems to me, therefore, that we are now compelled to admit two new facts:—(1) that large numbers of human leucocytes can be made to divide *in vitro*; and (2) that this division occurs entirely, or at least specially, in the presence of certain chemical substances.

In 1900 J. Loeb showed that parthenogenesis can be induced in the eggs of sea-urchins (Arbacia) by the addition of a definite proportion of MCl_2 to sea water; and since then many workers have studied such phenomena among other animals, while Wassilieff has used hyoscyamine, nicotine, and strychnine for similar researches. The independent observations now recorded would appear to extend cognate principles to body cells by showing that the division of leucocytes may be suddenly forced on at a great rate and in a few minutes by the absorption or presence of appropriate chemical agents, and may perhaps be inhibited by other chemical agents. The author added some remarks on the application of these observations to the genesis of tumours, and a discussion followed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. W. Bateson, F.R.S., honorary fellow of St. John's College, Cambridge, and director of the John Innes Horticultural Institution at Merton, Surrey, has been appointed the next Herbert Spencer lecturer. The subject of the lecture, which is announced to be given on Wednesday, February 28, 1912, will be "Biological Fact and the Structure of Society."

The following courses of lectures and laboratory instruction in mathematics, astronomy, and physical science have been announced for next term, which begins on Monday, January 22, 1912:—Prof. Esson, F.R.S., will lecture on the comparison of analytic and synthetic methods in the geometry of conics; Prof. Love, F.R.S., on rigid dynamics; Prof. Elliott, F.R.S., on elliptic functions and on the theory of numbers; Prof. Clifton, F.R.S., on optics and acoustics; Mr. J. Walker, on double refraction and polarisation of light. Practical instruction in physics will be given by Prof. Clifton, Mr. J. Walker, Mr. I. C. Griffith, Mr. O. F. Brown, and Mr. G. H. Clough. Prof. Townsend, F.R.S., will lecture on electromagnetic induction; Mr. E. S. Craig, on mechanics and physics. Practical instruction in the electrical laboratory will be given by Mr. F. B. Pidduck, Mr. E. S. Craig, Mr. H. T. Tizard, Mr. S. Smith, and Mr. W. B. Gill. Prof. C. F. Jenkin will lecture and give practical instruction on strength of materials and thermodynamics; Mr. D. R. Pye will lecture on drawing, for engineering students; Prof. H. H. Turner, F.R.S., will lecture on elementary mathematical astronomy.

DR. H. BASSETT, demonstrator and assistant lecturer in chemistry at the University of Liverpool, has been appointed professor of chemistry at University College, Reading.

DR. W. R. BOYCE GIBSON, lecturer in philosophy at the University of Liverpool, has been appointed by the council of the University of Melbourne to the chair of mental and moral philosophy.

THE President of the Board of Education has appointed Mr. L. A. Selby-Bigge, C.B., to be permanent secretary of the Board when that post is vacated by Sir Robert Morant, K.C.B., on his appointment to the Insurance Commission. Since 1908 Mr. Selby-Bigge has been principal assistant secretary of the elementary branch of the Board.

THE council of the Royal Horticultural Society has requested the following gentlemen to act as a committee to inquire into the desirability of establishing a National Diploma in Horticulture, and to recommend what steps, if any, should be taken for the purpose:—the Rt. Hon. A. H. Dyke Acland, Prof. W. Bateson, F.R.S., Mr. E. A. Bowles, Mr. F. J. Chittenden, Prof. J. B. Farmer, F.R.S., Mr. C. R. Fielder, Mr. W. Hales, Mr. J. Hudson, Prof. Keeble, Sir Daniel Morris, Lieut.-Colonel D. Prain, F.R.S., Mr. H. J. Veitch, and Mr. W. P. Wright.

THE London County Council has arranged to hold its sixteenth annual Conference of Teachers on three days, Thursday, January 4, Friday, January 5, and Saturday,

January 6, 1912. The meetings will be held at Birkbeck College, Bream's Buildings, Chancery Lane, E.C. There will be addresses and discussions under the heads of specialisation in schools; chalk, brush, and pencil work in elementary schools; the doctrine of formal training (mental discipline); the treatment of backward children; and educational experiments in schools. No charge will be made for admission to the conference. Application for tickets of admission should be made to the Chief Inspector, London County Council, Education Offices, Victoria Embankment, W.C.

IT is announced in the issue of *The London University Gazette* for November 29 that a donation of 1000*l*. has been made by Mr. and Mrs. Walter Baily, in celebration of their golden wedding, for the purpose of rearranging and decorating the interior of a portion of University College. From the same source we learn that the Galton Laboratory Appeal Fund now amounts to 2629*l*. 15*s*. 6*d*. The list of donations, many of which are conditional on the buildings being commenced within two years, includes gifts of 500*l*. from Mr. W. E. Darwin, and Prof. Karl Pearson, F.R.S., and Mrs. Pearson; 250*l*. each from Prof. Arthur Schuster, F.R.S., and Mr. E. G. Wheler; and 100*l*. each from the Earl of Rosebery, Viscount Iveagh, Mr. A. F. Butler, Major Leonard Darwin, the Hon. Rupert Guinness, and Major E. H. Hills, F.R.S.

AN interesting experiment is being tried by the local education authority of Plymouth with the view of arousing an interest in the study of science among the children in its schools. On December 8 Mr. C. Carus-Wilson lectured to five thousand children in the Plymouth Guildhall, taking "Volcanic Outbursts" as his subject. Each child paid one penny for admission to the lecture, and it is expected that no contribution from the rates will be necessary to meet the expenditure incurred. The children seem to have been thoroughly interested, and the education authority is likely to arrange a series of similar lectures in the future. Descriptive accounts of natural phenomena, when judiciously illustrated, appeal to most children, and many men of science trace their first enthusiasm for their subject to a good lecture, supplemented by telling experiments. The Plymouth experiment deserves to be copied in other large towns.

IT is not clear from the reports in the daily papers of a meeting held at Brighton on December 12 whether the intention is to establish a university or a university college in the town. *The Times* reports that the meeting was "in furtherance of the movement to make Brighton a university town," while *The Morning Post* states that at the meeting (over which the Mayor of Brighton presided) "the proposal to establish a college of university rank for the county was unanimously approved." There is, of course, a vast difference between the two proposals, but apparently it is a university college which Brighton has in mind, and not a university. Resolutions approving of the principle of the establishment of a university college for Sussex, and the appointment of general and executive committees, were carried unanimously at Tuesday's meeting. The Mayor of Brighton was elected chairman of the executive committee, and Mr. W. H. B. Fletcher, who has taken a prominent part in the educational affairs of West Sussex, vice-chairman.

AN interesting account of the way in which American agricultural experiment stations come into contact with the farmer is given in Bulletin 208 of the Agricultural Department of the University of Wisconsin. Crop demonstrations are arranged on twenty farms connected with various public institutions throughout the State, making use of seeds bred at the experiment station, and of methods of cultivation and manures that previous experiments had shown to be advantageous. The fields selected for these demonstrations are, so far as possible, chosen alongside of the public highways, where the operations and results can be seen by the farmer throughout the whole season as he drives to and from town. The local papers also contain accounts from time to time of the work done and the appearance of the crop. Some time during the summer, when the crops are at their best, a demonstration picnic is arranged, to which large numbers of farmers are invited, the average attendance last year being 320. These meetings occupy an entire day, and a definite programme is arranged dealing with six to eight subjects centring round the field work. The effective feature is the fact that all the practices suggested to the farmer are illustrated in operation on the farm, and the crops are there to show in concrete form what the results have been. The influence of the work is very great, many farmers putting the new methods into operation at once.

THE December issue of *The Reading University College Review* is one which reflects credit on the college. The most interesting feature to readers in general will be the forty pages of notes on the multifarious activities of the institution. From these we learn that the entry of new students for the present session was very satisfactory. The number of students taking degree courses is 114, of whom 44 belong to the faculty of science and 6 to the Department of Agriculture. During the previous session 80 students received instruction in the dairy institute, in which connection it is interesting to record that at the annual meeting of the Berks. and Oxon. Chamber of Agriculture the following resolution was passed:—"The Board of Agriculture having decided to establish a central research station for dairying, we, the Berks. and Oxon. Chamber of Agriculture, strongly urge that University College, Reading, which is already in close touch with agriculturists and farmers in Berks. and the adjoining counties, should be selected as that centre. Our contention is based on the fact that the college is situated in the centre of a large dairying district, and that in Reading it has the headquarters of this Chamber and of the Berks. and Adjoining Counties Dairy Farmers' Association, where it can readily consult the farmers of the district. Believing that such close relations are essential to any scheme of agricultural development, we are anxious to see advantage taken of the exceptional facilities afforded in Reading."

AT a dinner of the Clothworkers' Company held on December 6, the President of the Board of Education, replying to the toast of the Houses of Parliament, referred to the generous assistance rendered by the great City companies to the promotion of facilities for higher education in this country. The President said he found that the Goldsmiths' Company contributed 50,000*l*. to the new engineering buildings of the Imperial College of Science and Technology. The Drapers' Company contributed 10,000*l*. to the building fund of the new college at Bangor, and this year the Drapers' Company contributed 23,000*l*. to the physiological laboratory at Cambridge and 15,000*l*. to the University of Sheffield. This year the Clothworkers' Company contributed 5000*l*. to the textile industries department at Leeds University. The Merchant Taylors' Company maintain the Merchant Taylors' School, the Mercers' Company are identified with St. Paul's School, the Fishmongers' Company with the Gresham College, the Skinners' Company with Tonbridge School, and the Haberdashers' Company with Aske's Foundation. The Clothworkers' Company are second in the list of donors to the City and Guilds of London Institute. Words failed him, Mr. Pease said in conclusion, to commend sufficiently their liberality and generosity in the interests of education. The Clothworkers' Company has equipped the textile and dyeing department of Leeds University to the extent of 161,000*l*., and 75 per cent. of its income is contributed to the promotion of education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7.—Sir Archibald Geikie, K.C.B., president, in the chair.—Miss I. B. **Sollas** and Prof. W. J. **Sollas**: Lapworthura: a typical brittlestar of the Silurian age; with suggestions for a new classification of the Ophiuroidea.—Leonard **Hill** and Martin **Flack**: The physiological influence of ozone. Ozone, in concentrations of one part in a million and more, acts as an irritant to the respiratory tract, and diminishes the respiratory metabolism, as shown by the lessened output of carbonic acid and the diminished fall in body weight, which occur both during the period of administration and for some time after. Concentrations of several parts per million cause acute inflammatory congestion of the lungs, and

animals die as the result of this if kept long exposed to the ozone. Concentrations which can just be sensed by smell, i.e. far less than one part per million, have no injurious effect, and can be used safely in systems of ventilation. Injurious concentrations of ozone, by producing irritation of the air-passages, cough, and headache, compel anyone exposed to such to remove himself from the influence of ozone before any serious damage is done to the respiratory tract. Very low concentrations of ozone mask disagreeable smells, give a fresh quality to air vitiated by such smells, and vary the depressing monotony of air which is artificially warmed. Ozone may possibly have some use in the treatment of disease of the respiratory tract if used in concentrations which produce a slight irritation, and thus bring more blood and tissue lymph to the part.—H. R. **Dean**: The factors concerned in agglutination. (1) If, to a mixture of sheep corpuscles with antiserum so dilute that no agglutination is visible be added a solution of globulin obtained from normal guinea-pig serum, the corpuscles are markedly agglutinated. By use of suitable controls it can be demonstrated that neither the globulin solution nor the dilution of antiserum employed are of themselves capable of agglutinating the corpuscles. (2) The substance present in the globulin solution which aids agglutination is relatively thermostable, and its presence can be demonstrated in whole heated guinea-pig serum. (3) Corpuscles, sensitised and washed to remove free antibody, can be agglutinated by the globulin solution. If, after agglutination has taken place, the corpuscles be removed with a centrifuge, the supernatant fluid can be shown to have lost its agglutinating property. (4) The agglutinating power of an extremely dilute antityphoid serum can be increased by addition of globulin solution. Adding this to a mixture of emulsion of *B. typhosus* with a dilution of antiserum too weak by itself to agglutinate bacilli, distinct agglutination can be obtained. (5) Formation of a specific precipitate by interaction of serum and homologous antiserum depends on the presence in the mixture of a relatively large amount of antiserum. If to a mixture of serum with antiserum so diluted that it is no longer able to produce a precipitate is added the globulin solution, a definite turbidity is produced. (6) Probably agglutinating serum (antiserum) contains two factors, both of which are necessary to produce agglutination; one of these is the specific antibody, the other is a non-specific substance, possibly serum globulin. The interaction of antigen with antibody produces an aggregation of molecules of non-specific substance, which may ultimately result in formation of definite turbidity. This process of aggregation of the particles of non-specific substance is an essential part of the process of agglutination. It is possible to make a dilution of an antiserum which contains sufficient of specific anti-substance, but not sufficient of non-specific substance. Deficiency in non-specific substance can be made up by addition of globulin solution obtained from normal serum. —Arthur **Harden** and S. G. **Paine**: Action of dissolved substances upon the autofermentation of yeast. All dissolved substances which plasmolyse the yeast-cell also cause a large increase in the rate of autofermentation. Substances such as urea, which even in concentrated solution do not produce plasmolysis, have no accelerating effect. Toluene produces a similar effect to concentrated salt solutions. The effect produced by salts is probably a direct result of the concentration of the cell contents due to plasmolysis, but in the case of toluene it is possible that some other factor (such as disorganisation of the cell, or hormone action) is concerned.—Prof. G. **Dreyer** and W. **Ray**: Further experiments upon the blood volume of mammals and its relation to the surface area of the body. —G. W. **Ellis** and J. A. **Gardner**: The origin and destiny of cholesterol in the animal organism. Part viii.—On the cholesterol content of the liver of rabbits under various diets and during inanition. The authors have made analyses of the livers of a number of rabbits fed on the following diets:—cabbage, bran which had been extracted with ether, extracted bran to which cholesterol had been added. In some cases the cholesterol, instead of being given with the food, was injected in olive-oil solution into the peritoneal cavity. For animals fed on extracted bran alone the total liver cholesterol per kilog. of body weight is very constant, but when cholesterol is given with the food or injected into the peritoneal cavity a considerable increase takes place. A similar increase was observed in the liver cholesterol during inanition, when the animal lives on its own tissues. The percentage cholesterol content of the livers of newly-born animals is of the same order as that of normally fed adults. The results afford support to the working hypothesis, with regard to the origin and destiny of cholesterol in the organism, put forward some time ago by the authors, viz. that cholesterol is a constituent constantly present in all cells, and when these cells are broken down in the life process the cholesterol is not excreted as a waste product, but is utilised in the formation of new cells. A function of the liver is to break down dead cells, *e.g.* blood corpuscles, and eliminate their cholesterol in the bile. After the bile has been poured into the intestine in the processes of digestion, the cholesterol is reabsorbed, possibly in the form of esters, and carried in the blood stream to the various centres and tissues for reincorporation into the constitution of new cells.

Physical Society, November 24.—Dr. A. **Russell**: The maximum value of the electric stress between two unequal spherical electrodes. The experiments carried out by F. W. Peek (Journal Am. Inst. of Electrical Engineers, 1911) for the General Electric Company of America prove conclusively the value in practical work of a knowledge of how to compute the maximum value of the electric stress between high-pressure conductors. With equal spherical electrodes the electric stress between them can easily be computed from known tables. When, however, they are unequal the calculation becomes so laborious that it is prohibitive to nearly every experimenter. The author develops formulæ for this case, by means of which, and of the formulæ for the capacity coefficients given in a recent paper to the society, the calculation is very appreciably shortened. When the distance between the spheres is very small compared with the diameter of either, the following approximate formula for $R_{max.}$ (the maximum value of the electric stress) can be used

$$R_{max.}=(V/x)[1+(2b-a)x/(3ab)+\{4(a-b)^2+ab\}x^2/45a^2b^2)].$$

where V is the maximum P.D. between the electrodes, x their distance apart, a the radius of the smaller and b the radius of the larger sphere. In this case a knowledge of the values of the capacity coefficients is not required.—F. J. **Harlow**: The cubical expansion of fused silica. The author describes experiments in which measurements of the cubical coefficient of expansion of fused silica from 0° C. to 100° C., and from 0° C. to 184° C., were made by the weight thermometer method. The values obtained were ${}_0S_{100}=99\cdot8\times10^{-8}$ and ${}_0S_{184}=144\cdot7\times10^{-8}$. The fundamental coefficient is considerably less than that calculated from previous linear measurements, whereas ${}_0S_{184}$ is only slightly less. A low value of the fundamental coefficient is to be expected, since the coefficient has been shown to change sign at about $-80°$ C. Observations of the ice-point before and after heating showed that no permanent charge in the volume of the bulb occurred through heating, thus confirming the utility of fused silica for thermometric purposes.—B. W. **Clack**: The temperature coefficient of diffusion. The paper describes further experiments carried out by the author with an improved form of the apparatus previously described (Proc. Ph. Soc., xxi., p. 374), by means of which the value of the coefficient of diffusion of salts through water can be found at various temperatures. Special flasks, similar to those already employed, were filled with the solution under investigation, and one was suspended from each arm of the balance in a large bath of distilled water maintained at constant temperatures in a thermostat room. The diffusion tubes of both flasks were of equal length, but their cross-sections differed considerably, and a method of differential weighing was used to compensate for any small changes in temperature. From the rate at which the flasks change in weight the value of the coefficient of diffusion of the salts is deduced. Figures are given for this value in the case of KCl and KNO_3 at various concentrations and at different temperatures, and from these figures the temperature coefficient of diffusion is found.—E. **Marsden** and T. **Barratt**: The α particles emitted by the active deposits of thorium and actinium. In a previous paper (Proc. Phys. Soc., August) the authors showed that if α particles are

counted on a zinc sulphide screen at a mean rate of μ per second, then the probability of occurrence of a time interval, of length between t and $t+\delta t$, is $\mu e^{-\mu t}$. This formula may be applied to test whether two α particles are given off simultaneously from a disintegrating atom or whether in any source of α particles there exist two successive α-ray products, the latter being of short life. In the previous paper uranium and polonium were shown not to give such irregularities, and in the present paper the same result has been found for actinium and thorium active deposits, although experiments of various investigators pointed to the probability of positive results. The experiments further suggest a lateral disintegration in thorium active deposit, and this is proved to be the case by results, which show that the two α-ray products in Thor. Act. Dep. (Th. C_1 and C_2) do not give an equal number of α particles when the active deposit is in equilibrium which is required by the ordinary disintegration theory. Thus it is concluded that of the atoms Th. C, 35 per cent. give rise to α particles of 4·8 cm. range and 65 per cent. to α particles of 8·5 cm. range, with probably the intermediate emission of β particles. Various cognate questions are also discussed in the paper.—S. W. J. **Smith**, W. **White**, and S. G. **Barker**: The magnetic transition temperature of cementite. The temperature at which cementite (carbide of iron) loses its ferromagnetism is determined sufficiently accurately for purposes of thermo magnetic analysis, and examples are given to show the possibility of using the thermomagnetic properties of cementite to determine whether that substance is present in any iron-carbon alloy.

MANCHESTER.

Literary and Philosophical Society. November 28.—Prof. F. E. Weiss in the chair.—Dr. J. N. **Pring** and D. M. **Fairlie**: The synthesis of hydrocarbons and their stability at high temperatures and pressures. The reaction between carbon and hydrogen, which has been found to produce methane at all temperatures up to 1600°, has been examined at various pressures up to 200 atmospheres. In this way it has been possible to evaluate and verify the equilibrium in the formation of methane, arising according to the equation $C+2H_2 \rightleftarrows CH_4$. In accordance with this reaction it follows from the law of mass action that $\frac{pCH_4}{p(H_2)^2}=K$, a constant at any given temperature. This was found to be the case in these experiments when any particular form of carbon was used. The yield of methane was found to increase with the pressure to the extent demanded by the above formula. At atmospheric pressure the equilibrium value with graphite corresponds to 0·24 per cent. at 1200° and 0·06 per cent. at 1575°. Values which were considerably higher were obtained with amorphous carbon, viz. an equilibrium which corresponds to 0·38 per cent. at 1200° and 0·18 per cent. at 1550°. This divergence is due to the fact that amorphous carbon is unstable at these temperatures, and gives temporarily "false" or "metastable" equilibria, which are higher than the true values. The great inertness of methane to decomposition enables this false equilibrium value to persist for some time. The velocity of the reaction between carbon and hydrogen is very much increased at high pressures. No other saturated hydrocarbon is formed or can exist at temperatures above 1100°, and at pressures up to 200 atmospheres. The heat evolved in the transformation of carbon into graphite can be calculated from the data obtained in this work by means of certain deductions of van 't Hoff. The results show that this heat of transformation increases in the range of temperature between 1100° and 1600°. It follows from this, in accordance with the law of Kirchhoff, that the specific heat of carbon increases more rapidly and is higher than that of graphite at these temperatures, whereas the reverse would follow from the accepted values of Kuntz and of Weber, which do not therefore apply at high temperatures.

DUBLIN.

Royal Dublin Society. November 28.—Prof. T. Johnson in the chair.—Sir Howard **Grubb**: Improvements in equatorial telescope mountings. The paper is divided into two parts, one dealing with the anti-friction arrangements of the large equatorials which are at present in course of construction for Johannesburg, Santiago de Chile, and Madrid. This first portion of the paper describes the newly designed apparatus, and reports upon the result of the first trials. The apparatus described is a development of that used in Sir Howard Grubb's large instruments, improved in many ways and adapted for use with the modern ball or cylinder bearings, which have been found to give very satisfactory results. The second portion of the paper deals with a new arrangement for a differential hour circle. There are two designs described, one of which has been suggested by Sir David Gill, and is being adapted to the Johannesburg and Santiago telescopes. In this arrangement the differential hour circle is kept continually moving by a series of electric contacts from the sidereal clock of the observatory. The other form which has been designed by the author of the paper has been adapted to the Madrid equatorial, and in this case the differential hour circle is kept moving *backwards* as respects the polar axis by a small piece of clockwork carried on the axis itself, and this enables actual right ascensions to be read off by this circle from a fixed vernier.—Prof. T. **Johnson**: *Forbesia cancellata*, gen. et sp. nov. This fossil plant was collected by the Geological Survey of Ireland in 1851 from the Lower Carboniferous of co. Cork, and named in 1864 by W. H. Baily "Sphenopteris, sp." The fossil shows marked dichotomy in all its parts, even in the ultimate pinnule segmentation. There is no sign of vascular tissue, but axis and frond are alike honeycombed. The chambers are lined with rows of parenchymatous cells and their septa, apparently strengthened by sclerotic bands connected with submarginal vertical striæ. One specimen shows signs of a fruiting condition comparable with that in Cephalopteris, Nathorst, from the Upper Devonian of Bear Island. On the assumption that Forbesia is evascular, the author considers it to be the most primitive of the *primofilices* yet found. Comparison with *Sphenopteris devonica*, Unger and Richter, is made.

BOOKS RECEIVED.

Traum und Traumdeutung als Medizinisch-Naturwissenschaftliches Problem im Mittelalter. By Dr. P. Diepgen. Pp. 43. (Berlin: J. Springer.) 1.20 marks.

Traité complet d'analyse chimique appliquée aux essais industrielles. By Profs. J. Post and B. Neumann. Deux. édition française by G. Chenu and M. Pellet. Tome troisième—premier fascicule. Pp. 468. (Paris: A. Hermann & Fils.) 15 francs.

Traité de Physique. By Prof. O. D. Chwolson. Ouvrage traduit sur les éditions russe et allemande, E. Davaux. Deux. édition française. Tome premier, by E. Cosserat and F. Cosserat. Pp. xviii+515. (Paris: A. Hermann & Fils.) 17 francs.

Lehrbuch der Physik. By Prof. H. Ebert. Erster Band. Pp. xx + 661. (Leipzig: B. G. Teubner.) 14 marks.

Das Leben im Ozean nach Zählungen seiner Bewohner. By Prof. V. Hensen. Pp. v+406+28 Tabellen u. 1 Tafel. (Kiel: Lipsius & Tischer.)

Religion and Modern Psychology. By J. A. Hill. Pp. 200. (London: W. Rider and Son, Ltd.)

A Treatise on Hydrodynamics. Part i. Hydrostatics. By Dr. W. H. Besant and A. S. Ramsey. Seventh edition. Pp. 275. (London: G. Bell and Sons, Ltd.) 7*s*. 6*d*. net.

Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Six Years 1900–1905 under the direction of Dr. A. A. Rambaut, F.R.S. Vol. xlix. Pp. xx+304. (Oxford: H. Frowde.)

Aus Natur und Geisteswelt:—Die Milch und ihre Produkte, by Dr. A. Reitz; Die Kinematographie, by Dr. H. Lehmann; Die Sonne, by Dr. A. Krause; Probleme der modernen Astronomie, by Prof. S. Oppenheim; Einführung in die Biochemie, by Prof. W. Löb; Aus der Vorzeit der Erde, by Dr. F. Frech, i. to vi., Zweite Auflage; Das Süsswasser-Plankton, by Prof. O. Zacharias, Zweite Auflage; Moleküle, Atome, Weltäther, by Prof. G. Mie, Dritte Auflage. (Leipzig: B. G. Teubner.) 1.25 marks each.

Wirkungsweise und Gebrauch des Mikroskops und Seiner Hilfsapparate. By Prof. W. Scheffer. Pp. vii+116. (Leipzig: B. G. Teubner.) 2.40 marks.

Vorbereitungsbuch für den Experimentalunterricht in Chemie. By Prof. K. Scheid. Pp. vi+620. (Leipzig: B. G. Teubner.) 13 marks.

The "Wellcome" Photographic Exposure Record and Diary, 1912. Pp. 280. (London: Burroughs, Wellcome and Co.) 1*s.*

Farm and Garden Rule-book. By L. H. Bailey. Pp. xxiv+587. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

L'œuvre scientifique de Blaise Pascal. Bibliographie critique et analyse de tous les travaux qui s'y rapportent. By A. Maire. Pp. xxxi+184. (Paris: A. Hermann & Fils.) 15 francs.

Recent Methods in the Diagnosis and Treatment of Syphilis. The Wassermann Serum Reaction and Ehrlich's Salvarsan. By Dr. C. H. Browning, I. Mackenzie, and others. Pp. xxvi+303. (London: Constable and Co., Ltd.) 8*s.* 6*d.* net.

Tennyson and his Friends. Edited by Hallam, Lord Tennyson. Pp. xiv+503. (London: Macmillan and Co., Ltd.) 10*s.* net.

Elementary Graphic Statics. By Dr. W. J. Crawford. Pp. viii+131. (London: C. Griffin and Co., Ltd.) 2*s.* 6*d.* net.

A Compendium of Aviation and Aërostation: Balloons, Dirigibles, and Flying-machines. By Lieut.-Colonel H. Hoernes. Pp. xi+179. (London: C. Griffin and Co., Ltd.) 2*s.* 6*d.* net.

Geological and Topographical Maps: their Interpretation and Use. A Handbook for the Geologist and Civil Engineer. By Dr. A. R. Dwerryhouse. Pp. vii+133. (London: E. Arnold.) 4*s.* 6*d.* net.

Die Pflanzenwelt Dalmatiens. By Prof. L. Adamovic. Pp. vi+137+72 plates. (Leipzig: Dr. W. Klinkhardt.) 4.50 marks.

Philips' Comparative Series of Wall Atlases. *Europe.* Edited by J. F. Unstead and E. G. R. Taylor. 21*s.* Explanatory handbook to ditto, 6*d.* net. (London: G. Philip and Son, Ltd.)

Ancient Types of Man. By Prof. A. Keith. Pp. xix+151. (London: Harper and Bros.) 2*s.* 6*d.* net.

Prehistoric Japan. By Dr. N. G. Munro. Pp. xvii+705+plates. Reprint. (Edinburgh: W. Bryce.) 24*s.* net.

Mathematical and Physical Papers. By Lord Kelvin. Vol. vi. Voltaic Theory, Radio-activity, Electrions. Navigation and Tides. Miscellaneous. Arranged and revised, with brief annotations, by Sir J. Larmor. Pp. viii+378. (Cambridge: University Press.) 10*s.*

A Guide to the Fossil Invertebrate Animals in the Department of Geology and Palæontology in the British Museum (Natural History), Cromwell Road, London, S.W. Second edition. Pp. x+183+7 plates. (London: Printed by order of the Trustees.) 1*s.*

Prinzipien der Atomdynamik. By Prof. J. Stark. II. Teil:—Die elementare Strahlung. Pp. xv+286. (Leipzig: S. Hirzel.) 7.80 marks.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY OF ARTS, at 4.30.—The Fisheries of Bengal: Dr. J. Travis Jenkins.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Residence Tariffs: A. E. Seabrook.

CONCRETE INSTITUTE, at 8.—Some Recent Works in Reinforced Concrete: G. C. Workman.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Discussion:* Double-cutting and High-speed Planing Machines: J. Hartley Wicksteed.—*Probable Paper:* Oil-burning Locomotives on the Tehuantepec National Railway, Mexico: R. Godfrey Aston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests on Reinforced Concrete: E. F. Hunt.

MONDAY, DECEMBER 18.

ROYAL SOCIETY OF ARTS, at 8.—The Carbonisation of Coal: Prof. V. B. Lewes (Lecture IV.).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—American Deserts: Dr. T. McDougall.

INSTITUTE OF ACTUARIES, at 5.—Some Recent Statistical Results: W. Palin Elderton.

TUESDAY, DECEMBER 19.

PHYSICAL SOCIETY.—Annual Exhibition.

ROYAL STATISTICAL SOCIETY, at 5.—The Economic Position of Scotland and her Financial Relations with England and Ireland: E. Crammond.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Some Aspects of Railway Station and Goods Yard Illumination: Haydn T. Harrison.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* Experiments on the Strength and Fatigue Properties of Welded Joints in Iron and Steel: Dr. T. E. Stanton and J. R. Pannell.—*Probable Papers.* The Water Supply of the Witwatersrand: D. C. Leitch.—Investigations Relating to the Yield of a Catchment-Area in Cape Colony: E. C. Bartlett.

WEDNESDAY, DECEMBER 20.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Solar Halos and Brocken Spectres: Walter Larden.—The Statical Changes of Pressure and Temperature in a Column of Air that accompany Changes of Pressure at the Bottom: W. H. Dines, F.R.S.

GEOLOGICAL SOCIETY, at 8.—The Glacial Sections at Sudbury (Suffolk): Rev. Edwin Hill.—The Ordovician and Silurian Rocks of the Kilbride Peninsula (Mayo): C. I. Gardiner and Prof. S. H. Reynolds.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Photomicrography of the Electrical Reactions of the Heart: F. Shillington Scales.—British Tubificidæ: Rev. Hilderic Friend.

THURSDAY, DECEMBER 21.

INSTITUTION OF MINING AND METALLURGY, at 8.

LINNEAN SOCIETY, at 8.—Some Annelids of the Thames Valley: Rev. Hilderic Friend.—The Seedling Structure of Leguminosæ: R. C. Compton.—The Internodes of Calamites: Prof. Percy Groom.

CONTENTS.

THURSDAY, DECEMBER 21, 1911.

NOTES OF A NATURALIST.

Convergence in Evolution. By Dr. A. Willey, F.R.S. Pp. xiv+177. (London: John Murray, 1911.) Price 7*s.* 6*d.* net.

DR. WILLEY has had great opportunities of studying animal life under varied conditions, and he has given us in this interesting little volume some of the fruits of his observations. Here, in brief compass, will be found a zoologist's notes—field-notes and laboratory-notes—on points which have specially attracted him. Indeed, we think that some title suggesting that the book contained the varied observations of a zoologist would have been preferable to that which has been chosen. The book has been carefully edited and is well and clearly printed. One very conspicuous slip has, however, escaped notice, the reference to p. 90 instead of to 94 on the frontispiece itself.

The author tells us in the preface that he uses "the word convergence in a wide sense, embracing habits, functions, structures, and physiognomy." The sense is indeed so wide that the force of the term becomes attenuated. Thus even the convenient Box-and-Cox sleeping arrangements of the fruit-eating bats and crows in the maritime districts of Ceylon are classed as an instance "of convergent homing, the same trees affording hospitality in regular succession to day-flying birds and night-flying mammals" (p. 25).

Speaking of the well-known Kallima butterflies, the ordinary representation of the attitude is corrected, and it is shown that, at least in the Ceylon species (*K. philarchus*), the insect rests head downwards—a fact which has also been recorded of the Indian *K. inachis*. Concerning "the extreme amount of individual variation in the markings on the under side of wings, simulating all degrees of decay and discoloration and fungus attack" (p. 58), the author speaks with somewhat unnecessary respect of the notion

"that the constant repetition of such considerable variations as are met with in leaf-like Lepidoptera and Orthoptera, from generation to generation, is a standing witness against the truth of 'Darwinism,' inasmuch as, according to the Darwinian theory, such variations ought either to become fixed by natural selection or swamped by interbreeding" (p. 61).

The tentative suggestion on p. 61, "it may be that natural selection is interested in keeping alive the variations for the benefit of the species, not for the production of new species," may be accepted with some confidence when such polymorphic forms are looked at as a whole. If it be an advantage in the struggle for existence to resemble a dead leaf or another butterfly of a distasteful group, it is clearly a still greater advantage to resemble two or more kinds of dead leaf, or two or more unpalatable "models." It must be remembered that Kallima is by no means remarkable in this respect, for such polymorphism is well known in immense numbers of both procryptic and mimetic species.

It is satisfactory to find that such an extreme supporter of the far-reaching influence of convergence does not, at any rate for the present, assail the Darwinian conclusion that the same specific form is never repeated a second time as the outcome of an independent line of evolution.

"The present state of our knowledge," he writes on p. 138, "justifies the provisional assertion that the higher combination which leads to the establishment of an animal form possessing the essential component elements of a definite morphological type, cannot be repeated. The theory of convergence is therefore not calculated to precipitate us into morphological chaos, howsoever startling its manifestations may be."

The author is certainly prepared to be startling, as, for instance, in his conclusion that the closed nephridia as a whole, flame-cells (or solenocytes) and all, arose independently in the Polychæte worms and in Amphioxus. But before adopting any such hypothesis, it is prudent to investigate the evidence that these structures were present in the probable common ancestor of both Amphioxus and Polychæta. That such nephridia did thus exist in the primitive stock is strongly supported by their occurrence in several other groups which are much nearer to the common ancestor than either Amphioxus or the Polychæta. We have reason to believe that E. S. Goodrich, who originally discovered the resemblance in minute detail between the solenocytes of these two forms, considers that his conclusions have been much strengthened by the results of investigations on other groups of the Cœlomata.

There can be no doubt, however, that the independent origin of elaborate structures has occurred again and again. There is scarcely a subject in which it is more necessary to bear in mind the commonplace saying that every case must be argued on its merits without any bias in favour of one interpretation rather than another.

An excellent example of convergence in a structure of considerable complexity was brought forward more than thirty years ago by Fritz Müller. At the same time, we must remember that the male scent-organs on the wings of butterflies, to which he was referring, are constructed of modified scales—elements which are so excessively variable in size, form, and structure that the independent appearance of anything that can be produced by a scale is probably easier than almost any other feat of convergent evolution. Speaking of the scent-organs on the wings of certain male Satyrine and Nymphaline butterflies, Fritz Müller wrote:—

"I know of no other case which proves so clearly and irrefragably, and attests with such force, the truth of a principle which should never be lost sight of in morphological studies. When in two species certain organs which serve the same function are found in the same place, are composed of the same parts, occupying the same relative positions, and exhibiting similar forms—all this by itself constitutes no sufficient proof that these organs are homologous, nor does it afford the grounds for including the two species in the same family." [1]

E. B. P.

[1] *Arch. Mus. Nac. Rio de Janeiro*, iii. (1878), pp. 1-7.

CHEMISTRY OF FLOUR.

The Technology of Bread-making, including the Chemistry and Analytical and Practical Testing of Wheat, Flour, and other Materials Employed in Bread-making and Confectionery. By Wm. Jago and Wm. C. Jago. Pp. viii+908. (London: Simpkin, Marshall and Co., Ltd., 1911.) Price 21s. net.

THIS, the second, edition of a well-known work has been increased greatly, both in bulk and price, over its predecessors. Mr. Jago has had the cooperation of his son in its preparation.

It is far from easy to review at all adequately a book of 893 pages, and undoubtedly the work would have been of greater value if it had been materially condensed. Like most similar technological works, it commences with a good deal of pure chemistry, which is partly of very elementary character; very nearly all this could have been omitted with advantage.

The new edition contains most of the previous issue in its original form, but supplemented very fully by the additions required to bring it up to date. Whilst this has been done in a most painstaking and satisfactory manner, the practice is a mistaken one, if a really good book is to be produced, however much it may be justified by commercial reasons. As a result, the treatment is unequal; it would be unjust, however, to base any general criticism on these sections.

The usual plan adopted by the authors is to give a full abstract of all scientific papers in any way bearing on their subject. These are ordered, as a rule, in historical sequence, occasionally with the annoying result that, after a paper has been mastered by the reader, he finds the results controverted by the next paper. It is difficult in consequence to make out the authors' own views in places or to take a clear line as to the current opinions on a controversial question. The authors' own researches are interpolated at considerable length, and, though always valuable, their insertion sometimes tends to confuse the reader seeking for definite conclusions rather than the minutiæ of experimental detail.

The chemistry of bread and flour is far from being in such a chaotic state as this work would lead us to believe; it should have been possible to give a precise account of the present position and to indicate the controversial points, leaving the discussion of these at length to separate chapters.

Apart from these defects the book is most complete, and Mr. Jago is at his best in dealing with the more technical side of the question. Such chapters as those on the composition of wheat, the strength, composition, and bleaching of flour are full of valuable information. Mr. Jago, it is interesting to note, cannot agree with the so-called food reformers in their condemnation of our present bread supply, and the evidence he quotes shows that he is supported in this view by all the authorities of repute in this and other countries. The chapters on bread-making, wheat, flour, and bread "improvers" and on the nutritive value of bread, give a complete summary of all that is known at present on these questions.

The subjects of bakehouse design and the machine bakery and its management will appeal specially to those actually engaged in the trade—a baker, seeking to modernise his equipment, will gain the very best value for his outlay by studying them here.

The commercial testing of wheats and flours constitutes a very important section of the work: the subject is a difficult one, and much of the knowledge of it is still regarded as a trade secret. The difficulty chiefly lies in translating the results of the chemical tests into facts. There is much rivalry between the respective merits of the "chemical" and "baking" tests on flour; as Mr. Jago points out, "though baking is after all the final test of flour," chemical analysis is often able, not only to point out a departure from the normal, but, what is more important, to discover the cause. Millers and bakers have been slow as yet to follow the lead of the brewing industry and introduce a chemist into the works, but where this has been done there is abundant evidence that the laboratory work has proved an actual necessity for the maintenance of a uniform product of high quality. A very flattering testimony to this effect from the Ogilvie Flour Mills Co. is quoted in the book. The authors give of their best in this chapter, the pages describing the tests made with the aid of the tintometer being of especial interest as affording a means of measuring some of the subtle changes which take place in flour on storage, and giving more than a clue to their causes.

The more purely analytical chapters which conclude the book are in some respects less successful, some of the methods described being antiquated and untrustworthy. None the less, the section is a useful one to bakers' chemists, who will appreciate also the pages devoted to the testing of confectioners' raw materials.

Perhaps the most striking thought after a perusal of the book is how much of the present knowledge of the chemistry of wheat and flour is due to the work of the last few years, particularly to investigations instituted by those only remotely connected with the subject, and performed without thought of pecuniary reward. Additional satisfaction is derived from the consideration that the advance has been mainly made in this country, or by workers in Canada and the United States.

In conclusion, the authors may be congratulated on the result of their labours; they have compiled a dictionary which leaves nothing to be desired in the fulness of its material, and they have earned the gratitude of all future workers in the field.

E. F. A.

THE COLLOIDAL STATE.

Gedenkboek aangeboden aan J. M. van Bemmelen, 1830–1910. Pp. xxix+416. (Helder: C. de Boer, 1910.)

FIFTEEN years ago the number of those investigating the colloidal state would scarcely have reached double figures, and in the text-books of the period the subject received curt dismissal in a few paragraphs. Had it not been for the connection between colloids and dialysis it would have escaped

mention altogether. The general position of the science was but little advanced beyond where Graham in especial, and others, such as Frankenheim, Lüdwig, Cloetta, and Payen, had left it half a century earlier. Outside Prof. van Bemmelen's work a few scattered papers, mainly on the precipitating power of salts, or on the imbibition of water by organic jellies, made up the literature of the period. Biologists as a class seemed to have forgotten even the name colloid.

The sixty-two original papers gathered into the volume before us is eloquent testimony to the change which has taken place. The colloidal state has become the vogue, and any departure from simple linear relationship in the equilibrium between states of matter is in danger of being called colloidal—subclass adsorption—and so receiving summary and satisfactory explanation.

The historical position is, however, strictly logical, as indeed it must be if it is, in fact, a development of ideas. In the 'fifties and 'sixties of last century much work and speculation were devoted to the colloidal state; Frankenheim's forgotten paper of 1850, for instance, deserves to rank with Graham's masterwork. But the movement soon spent itself for lack of foundations to build upon.

The present era begins in 1873 with the appearance of the remarkable synthesis which van der Waals effected between the Laplace-Young theory of self-attractive matter, purely statical in character, and the doctrines of molecular kinematics as Clausius especially had developed them; and in 1875, with the equally remarkable extension of the theory of energy to include chemical potential which was made by Willard Gibbs. These, together with van 't Hoff's extension of the gas laws to solutes and Arrhenius's conception of electrolytic dissociation, opened the way for a great mass of work on the equilibrium between different states and different kinds of matter which expanded molecular physics into what is now called physical chemistry. This movement in turn has largely spent itself, unfortunately before it has given us a trustworthy specification of the distribution of energy in the fluid and solid states, and the study of the equilibria of matter in mass has, in one direction, been largely replaced by the study of heterogeneous systems in which one at least of the states is not present in mass at all, for this is the distinctive feature of what is called the colloidal state.

The papers in the memorial volume are forcible evidence of the multitude of problems connected with the colloidal state. Surface energy, the condensation of matter on to interfaces, osmotic pressure and dialysis, the physical state of soils, colloids in geology, viscosity, precipitation, and contact potential all are dealt with. The subject-matter of the paper by M. Duhem, which opens the series, must have been peculiarly grateful to van Bemmelen, for it is a protest against the application of thermodynamics to colloids on the assumption that they are multiphase systems. Twelve years ago the writer of this notice received from Prof. van Bemmelen a long letter of protest against any attempt to apply the phase rule to colloids, and the protest was in the main just. Equally favourable must have been his reception of Malfitano's protest against certain arbitrary distinctions which have become current, chiefly the distinction between chemical combination and adsorption. The distinction may have to be made, but it needs more subtle treatment than it usually receives.

Van Bemmelen's first work on colloids was his paper of 1877 on the absorptive property of soil, his last the paper, "Die Absorption, X.," of 1909. He was nearly fifty, an age when many cease active research, before he began his life-work. As van Bemmelen was led to colloids by his study of soils, it is but fitting that the volume should contain an important group of papers on colloids of the soil and in geology. Rohland, Hissink, Leopold, van Baren, Ehrenberg and Pick, Holwerda and Hudig write on these subjects. M. le Chatelier deals with the mechanical properties of mixtures of solid and liquid in a paper which is remarkable in that it makes no mention of Osborne Reynolds's work.

It is not possible to accord even the briefest notice to all, and contributions by Pappada, Tamman, Barus, Jordis, Freundlich, Spring, Svendburg, Bredig, Ringer, Schreinemakers, Lorentz, and others must be passed by with the remark that, as many of them will not appear in print elsewhere, the volume must be consulted by all workers on colloids.

His eightieth birthday saw van Bemmelen stricken with what proved to be his last illness. His modest soul was, above all whom the writer has known, superior to the need of praise. Thirty years' patient labour in a neglected field of science proves this. Yet one likes to think that so abundant testimony to regard and esteem brought joy and courage in those last hours.

W. B. HARDY.

THE ANALYSIS OF DYES AND DYED MATERIALS.

Identification of the Commercial Dyestuffs: being vol. iii. of a Method for the Identification of Pure Organic Compounds by a Systematic Analytical Procedure based on Physical Properties and Chemical Reactions. By Prof. S. P. Mulliken. Pp. vi+274. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 21s. net.

THE identification of natural or artificial dyestuffs either as such or in association with textile fibres, colour lakes, paper, food, or other articles, is a problem which at the present day presents many difficulties. Twenty or thirty years ago the number of dyestuffs was so small that their identification by an expert was a simple enough matter, but the enormously greater number of artificial dyestuffs now in use and the rapid rate at which this number is daily augmented, has not only greatly increased the difficulty, but also the need of trustworthy means of analysis. The dyer with many hundreds of dyestuffs now at his command is able to match any particular shade in a variety of different ways, but since the fastness for the purpose in view depends entirely upon a suitable choice of colouring matters, it becomes particularly important that in matching an approved pattern it should be possible not only to reproduce the shade, but also to

select the same or similar dyestuffs. It is also a desideratum for the merchant or textile manufacturer to be able to ascertain whether the colour of the materials dyed for him is always obtained with the dyestuffs specified, whether the shade dyed by one firm is or is not a chemical match for that dyed by another, and other similar questions. The analytical chemist is also frequently called upon to determine the actual dyestuff or dyestuffs employed, for example, in the composition of a lake pigment for wall-papers or lithographic printing, or to identify the material used for colouring certain food products.

With the large number of dyestuffs which come into consideration it is obvious that no satisfactory scheme of identification can be based upon individual and empirical reactions, such, for instance, as the changes of colour produced by caustic soda or concentrated sulphuric acid. Such individual tests can only be employed effectively after the genetic relationships of the dyestuff in question have been ascertained by means of suitable group reagents; and only those chemical properties can be employed as group reactions which depend upon general differences in chemical structure. Another reason why such a principle can alone prove satisfactory is that the scheme adopted must be capable of including and referring to their appropriate groups the new colouring matters which are constantly appearing, the individual reactions of which are unknown.

In the analytical scheme published by A. G. Green in 1893, which is based in part upon the earlier schemes of Witt and Weingaertner, the chief differentiation is effected by the behaviour of the dyestuff upon reduction with zinc dust, and the reaction of its reduction products with air and with chromic acid. Whilst nitro-, nitroso-, and azo-compounds are completely broken down upon reduction, and cannot therefore be reoxidised, those dyestuffs which may be regarded as having an *ortho*-quinonoid structure give leuco-compounds which are readily reoxidised to the original dyestuff by air, and those to which a *para*-quinonoid structure is attributable give leuco-compounds stable to air but reoxidised by chromic acid. Still, a further group are not reducible at all, whilst dyestuffs of the anthracene class are converted into coloured hydro-derivatives.

In 1905 and 1907, Green, assisted by Yeoman, Jones, Haley, and Stephens, published a very complete scheme for the analysis of dyestuffs upon textile fibres, in which the above principles were employed in conjunction with other group tests. In this scheme sodium hydrosulphite was substituted for zinc dust as the reducing agent, and the colourless potassium persulphate for chromic acid, all the reactions being effected upon the fibre instead of in solution. This scheme of analysis is not only applicable to dyed materials, but can also be readily applied to colouring matters in the solid form or when associated with mineral bases, food products, &c., by previously transferring the dyestuff to wool or cotton.

In the work under review the author claims to have produced a perfected scheme of analysis of general applicability. In place of employing group reactions to differentiate the dyestuffs according to their structural relationships and dyeing properties, the system adopted is largely empirical, being based upon the exact determination of colour changes effected by various reagents, the shades obtained being compared with standard shade cards and the results tabulated by a system of lettering. Although Green's reduction and oxidation tests are also employed as "generic" reactions, their indications are interpreted in a strictly formal manner under arbitrary but rigidly fixed conditions. This produces the result that the main groups or "genera" frequently contain dyestuffs which are entirely unrelated. We find, for instance, azo-colours of the benzopurpurine type classified together with rhodamine (a pyrone colour); phosphine and other acridine colours classified with annatto; auramine (a diphenylmethane derivative) in association with primuline (a compound of the thiazol class); various alizarine colours in close conjunction with rose Bengal and violamines (pyrone colours); and dyes of the azo-class, triphenylmethanes, and natural red woods amongst the azines, oxazines, and thiazines. The author's system also involves the coordination of dyestuffs of entirely different dyeing properties, irrespective of whether they are "basic," "acid," "substantive," or "mordant" colours.

The book contains colour reactions of some 1475 individual dyestuffs, which are recorded with extreme precision for the selected conditions. Although, however, it has involved much careful labour, the utility of the work has been largely sacrificed to the desire to obtain an impossible degree of accuracy and through the unscientific and inconvenient system of differentiation adopted. Such a rigid system of colour reactions does not take account of the fact that commercial dyestuffs usually contain variable impurities or are shaded with small quantities of other colouring matters. Furthermore, it may be questioned whether the exact tint obtained in the tests would not be also affected by small indeterminate factors, such as the purity of the reagents or the quality of the textile materials used in dyeing. Lastly, the scheme could not be applied to mixtures without a complete separation into the constituents, a condition which is seldom possible.

ARTHUR G. GREEN.

MUNICIPAL ENGINEERING.

A Manual of Civil Engineering Practice: Specially arranged for the Use of Municipal and County Engineers. By F. Noel Taylor. Pp. xii+809. (London: C. Griffin and Co., Ltd., 1911.) Price 25*s*. net.

THIS book has been written to supply the needs of young engineers who propose to devote themselves to those branches of engineering practice which fall to the lot of the municipal and county engineer, or the borough surveyor; the duties which have to be undertaken by such officials are of a most varied character, and involve a wide range of knowledge; books of reference are essential to such men, and Mr. Taylor, drawing largely upon his own professional experience, has dealt with the entire field of work covered by the term "municipal civil engineering."

The first six chapters are devoted to surveying and levelling, and the mensuration of earthworks, the subject being treated with special reference to the class of work which has to be carried out by municipal engineers, such as the laying out of roads, tram-lines, sewers, &c.; next follow three chapters dealing with such general problems as the stresses and strains in beams and struts under given loading, and the methods of determining the necessary scantlings of simple beams and pillars. In a special chapter on the various materials employed in constructional work, the author gives a concise description of their structure, essential properties, manufacture, and the usual methods of testing them to ensure soundness and freedom from all defects. Retaining walls and their design are fully discussed in chapter xvi., and examples are worked out to illustrate the use of the formulæ and the methods of securing safety with economy of material.

The making and repair of roads form a very important part of the duty of a municipal engineer: prior to the advent of the motor-car, the roads outside town areas had been much neglected, and they were in a totally inadequate condition to deal with fast and heavy traffic; as a consequence the questions of road maintenance and road construction have entered during the past ten years upon an entirely new phase. To mention only one of the changed conditions, with horse traffic the dust nuisance was, in country districts, a matter of slight importance; at the present day, on roads on which there is a heavy motor-car traffic, the suppression of dust becomes a factor which must be dealt with, and to which other details may have to be subordinated. In chapter xix. the author gives an excellent abstract of a report upon the proceedings of the International Road Congress, which met in Paris in 1908, prepared for the Local Government Board of Ireland by the chief engineer, Mr. Cowan. This congress agreed to a series of resolutions embodying the views of the delegates as to the lines upon which in the future roads should be constructed and maintained, and also as to how best to cope with the dust problem, though at present opinion is divided as to the respective merits of surface tarring and tar-macadam.

A valuable chapter is that devoted to the design of structures in reinforced concrete; some excellent notes are given as to the essential qualities of the two materials employed—the concrete and the steel—then a series of simple formulæ is worked out, and, finally, typical illustrations of design are given, such as floors, piles, reservoir walls, bridges, and sewers, in each case attention being directed to practical difficulties which have to be met and overcome, if thoroughly sound, durable work is to be produced. This chapter is appropriately followed by one on masonry road bridges and similar work.

The problem of the removal of domestic and trade refuse, solid and liquid, is dealt with in six very complete chapters—one of the best sections, in fact, of the book. All the most modern and efficient methods are discussed and explained, both in regard to the laying out and the construction of sewers, and in regard to the ultimate treatment of the sewage at the outfall works. An abstract is given of the report of the Royal Commission on Sewage Disposal of 1908, a report which embodies the views of chemists, biologists, and engineers, and is a storehouse of information upon a subject which is of vital importance to the general public, and the layman is as much concerned with the efficient solution of this knotty problem as the engineers who have to design and maintain the necessary works. To make this section of the book complete, the author has added a chapter on the ventilation of buildings and house drainage, in which the best types of modern sanitary house fittings are described, with the help of a series of good illustrations.

Waterworks, their design and maintenance, form the subject of three chapters. Full details are given of the best system of filtration, of methods of softening hard waters so as to render them more suitable for domestic purposes, and of detecting and checking waste of water, a constant source of worry to the engineer in charge of such works; some figures are given to show how excessive this waste by leakage and by the culpable negligence of householders may be, and how important it is to put a stop to it, if needless expense in constructional works is to be avoided, and a shortage of supply in periods of drought prevented.

Constructional steel work is discussed in a very complete chapter. The examples chosen cover a wide range of such class of work—overhead water tanks, roofs, and bridges of various type. The illustrations in this chapter are clear and not overburdened with detail, and are, therefore, much more likely to prove useful to a designer who consults them than is often the case with plates reproducing engineering drawings. For the guidance of young engineers, Mr. Taylor has given a special chapter to the subject of the preparation and drafting of specifications, a chapter which will no doubt be constantly consulted, as it is full of the most useful hints and advice.

Mr. Taylor is to be congratulated on the production of a book which will find a place on the desk and in the drawing office of every civil engineer, and the publishers, too, must be given a word of praise for the excellence of the numerous plates and wood-cuts.

T. H. B.

CHEMICAL PHENOMENA OF LIFE.

Chemical Phenomena in Life. By Prof. F. Czapek. Pp. ix+152. (Harper's Library of Living Thought.) (London and New York: Harper and Bros., 1911.) Price 2s. 6d. net.

MESSRS. HARPER could not have secured a more authoritative or a clearer writer than Prof. Czapek, of Prague, to present to the public the most recent views of biochemistry. The chemistry of protoplasm and its behaviour, as well as that of its constituents, have been greatly illuminated since that branch of chemistry known as the chemistry of colloids has been subjected to investigation. The main properties of colloids were discovered by Thomas Graham in 1861, and the conception of ions we owe to Faraday. Nevertheless, the science of physical

chemistry remained in a dormant condition until van 't Hoff and Le Bel, twenty-one years ago, laid down the famous law named after them, and put forward their views on the nature of solutions. Exact and even mathematical researches in this region were thus rendered possible, and physical chemistry since then has grown at a prodigious rate, and has increased the boundaries of knowledge, not only so far as chemistry and physics are concerned, but also in the biological field as well.

Unfortunately the growth of a new science means the introduction of a new language, and those who write in it are not always able to realise that it is unintelligible even to those who have received a scientific training a few years previously. Such a book as Prof. Czapek's is therefore a godsend, for it explains in the clearest manner the new language as well as the new facts. Although the author is a professor of plant physiology, he treats his subject in a wide manner, so as to be helpful to animal physiologists as well. The properties of colloids, the use of the ultra-microscope, the significance of the protoplasmic membrane, the velocity of reactions, catalysis and the enzymes, and the general laws of immunity are among the subjects treated in somewhat less than 150 small pages. Each page is rich with information and full of thoughtful and pregnant suggestions.

Prof. Czapek concludes that, so far as chemical and physical phenomena are concerned, our knowledge is now sufficiently advanced for us to be quite sure that it is unnecessary to call in the assistance of any mysterious "vital force" in order to explain the activities of protoplasm. The filling in of the still numerous gaps are mostly the working out of points of detail, and that is only a matter of time.

"There is only one part of physiology which is not yet accessible to our methods, and which we cannot prove to be ruled by the well-known laws of inanimate nature. These are the psychological phenomena."

When we remember that less than a century ago organic chemistry was regarded as equally inaccessible to experimental methods, there is some hope that in the future even psychological phenomena may yield their secrets to the investigator. W. D. H.

OUR BOOK SHELF.

Where Do We Come From? Is Darwin Correct? A Philosophical and Critical Study of Darwin's Theory of "Natural Selection." By Herbert Morse. Pp. iv+344. (London: Kegan Paul and Co., Ltd., 1911.) Price 7*s.* 6*d.* net.

HAVING read many of the eulogistic articles on Darwin's work which appeared at the time of his centenary, Mr. Morse was prompted to look into the matter for himself. He does not claim for his work any higher authority than that to be granted to the opinion of the man in the street. "Anyone who can read and write, who has the ordinary powers of reasoning, and is possessed of some knowledge of the nature and value of evidence, is as capable of passing as sound an opinion on the value of the theory, that, that evidence endeavours to corroborate as any scientist of them all."

Let us give a few quotations to illustrate the competence and temper of this new philosophical critic. "Man is a self-improving organism, no other organism is. Every other organism is the mere sport of nature, at the mercy of environment, a mere physical puppet." The struggle for existence "was the great promoter and agent of variation." This, which is stated as one of Darwin's fundamental propositions, reveals an abyss of misunderstanding. We are treated, as usual, to the old chestnut: "If these new creations were all similar at the outset, it seems inconceivable that any period of time, however prodigious, or any set of circumstances, however extravagant, could by any process of slow accretion have converted, say, a flea into a flamingo."

The author is therefore led to suppose that there were many independently originating primitive organisms. He appears to believe that a theory of polyphyletic evolution is quite anti-Darwinian, and he brings back old times by dividing the animal kingdom into four classes. There have been many stern critics of Darwinism who have done service to evolution-theory, advancing it a little beyond the stage at which Darwin left it, but these have been men careful to understand what Darwin meant, careful not to credit him with conclusions he did not hold, careful to acquaint themselves with the facts of the case. We cannot rank Mr. Morse among these.

The World's Minerals. By Leonard J. Spencer. Pp. xi+212+40 coloured plates. (London and Edinburgh: W. and R. Chambers, Ltd., 1911.) Price 5*s.*

AT first sight one gains the impression that this is merely a remarkably cheap picture-book, published in time to be handy as a Christmas gift. The forty coloured plates exhibit an Oriental splendour and a daring which does not hesitate to represent the play of colours of labradorite and precious opal, or even the metallic lustre of native gold and silver. These dazzling pictures, prepared under Dr. Hans Lenk, of Erlangen, are themselves worth the price of the book, which, however, is far more than a mere album of German chromo-lithographs. For the editor of *The Mineralogical Magazine* has written descriptive text around the pictures, and has preceded this by an excellent introduction to the study of minerals, which makes the book something more than a pretty volume for collectors of pretty stones. Thus in only twenty-two pages the author manages to give a clear and wonderfully comprehensive survey of the difficult subject of crystallography, not even omitting to deal with Miller's notation.

On p. 16 the choice of 2 for the axial ratio of a dimetric crystal is unfortunate, suggesting as it does a simplicity comparable to that of indices, dealt with in the same paragraph. A figure like the 1·771 of anatase would have avoided any such implication. On p. 20 the drawings of rhombohedra are apparently printed upside down, and the hexagonal prism is not satisfactory. These are, however, minor points, and the fact that one can find no worse faults in what amounts to a text-book of systematic mineralogy comprised in the first forty pages, on the forms, physical characters, chemical composition, and classification of minerals, speaks well for the value and accuracy of the work. R. F. G.

The Rubber-Planter's Notebook. By Frank Braham. Pp. viii+108. (London: Crosby Lockwood and Son, 1911.) Price 2*s.* 6*d.* net.

THIS book is what it purports to be, a handy book of reference on Para rubber planting, with hints on the maintenance of health in the tropics and other general information of utility to the rubber planter. It is well written, and the condensed information contained in

it, so far as it goes, is well selected and in the main correct.

Many a "creeper" and new hand on Eastern estates and elsewhere will owe Mr. Frank Braham a debt of gratitude for this handy little volume, which doubtless is the nucleus of a future work of more extended scope, not one with large type on art paper, but a planter's "Molesworth," of use to the old hand as well as to the beginner.

The author's section on general information will be found specially useful, and his essential rules for the preservation of health in tropical climates are admirable if intended for the young planter going out to the East for the first time; but for the older resident in the tropics "drink as little as possible—fluids inflate the bowel" is dangerous advice. The ingestion of a sufficient quantity of water or other bland liquid is essential if for no other reason than to counterbalance the effects of excessive perspiration. In hot weather the kidneys are very largely relieved of their excretory duties by the skin. If then the individual for years has been in the habit of still further relieving them by drinking as little as possible, it is not astonishing that in cases of emergency they are unable to return to their normal state of efficiency, and if blackwater fever is encountered death in such cases may be the result.

In these essential rules also mention of the all-important hot bath and change at sundown would have added to their completeness. The book, however, should command a ready sale.

Die moderne graphische Reproduktion. Ein Führer und Ratgeber durch das Gebiet des Illustrationswesens unter Berücksichtigung der für die Wiedergabe bestimmten Originale. Gemeinverständlich dargestellt von L. P. Mosler. Pp. vi+52+xiv plates. (Jena: Gustav Fischer, 1911.) Price 2 marks.

IN this booklet the author gives a concise description of the methods of illustration as at present practised, so that those who desire to avail themselves of such methods may have some idea of their characteristics and possibilities, and be guided as to their choice. He refers also, shortly, to methods of making drawings and photographs for reproduction. Following the text are fourteen plates. Nine of these are impressions from half-tone blocks made from the same original to show the effect of the fineness of the screen, a reproduction of a reproduction, a "duplex" print, &c. There are also a four-colour print, a collotype, and a photogravure.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Distastefulness of *Anosia plexippus*.

REFERRING to the interesting note on "The Distastefulness of *Anosia plexippus*" in NATURE of October 12, I should like to suggest that the experiment, though interesting in itself, does not materially strengthen the case for the usefulness of mimicry. To make a good case for mimicry in the sense in which that term is ordinarily used, the mimic *Basilarchia archippus* should be tested and found palatable. Further, if mimicry means anything at all with reference to these two species, North American birds should eat some butterflies but not molest *Basilarchia archippus*. So far as observations have been reported, American birds eat butterflies *very* rarely, and there is no evidence, so far as I know, either from direct observation or from the thousands of stomach-content examinations made by the United States Department of Agriculture, that its non-mimetic relatives are eaten more often than *Basilarchia archippus*.

If European birds show the same indifference towards butterflies as is manifested by North American birds, either the "model," *Anosia plexippus*, or the mimic, *Basilarchia archippus*, might with impunity become widely disseminated in Europe. A. M. BANTA.

Cold Spring Harbor, N.Y., November 20.

I HAVE a shrewd suspicion that if the result of my experiments upon *Anosia plexippus* had proved this butterfly to be highly palatable, the dwindling minority of mimicry sceptics would have made the very most of the fact, and claimed that it "materially strengthened the case" against Bates's theory of mimetic resemblances; and in this they would have been perfectly right, so far, at all events, as the particular instance is concerned. But since the experiments proved the precise opposite, those who believe in the theory may reasonably maintain that the case for the usefulness of the mimicry to *Basilarchia archippus* is thereby materially strengthened. It appears to me that few more important items of evidence in favour of the theory of mimicry can be established than demonstration of the distastefulness of "models."

Again, I think Mr. Banta overrates the negative evidence he cites in support of the view that birds seldom prey upon butterflies under natural conditions. My opinion to the contrary is based upon a large number of experiments made in the gardens of the Zoological Society of London, and published in the Proceedings of the society for September. I can recollect no exception to the rule that insectivorous birds were roused to attention at once by the sight of butterflies, their keenness suggesting very forcibly that they knew them, either by instinct or by experience, to be part of their natural diet.

Not less strongly suggestive was the determination with which they pursued, and the precision with which they generally caught, the butterflies on the wing when let loose in the shelterless aviary. Conversely, the skill evinced by the butterflies in dodging their pursuers in mid air was one of the most striking features of the experiments. Just as one is compelled to believe that the instinctive doubling of the coursed hare when overtaken by greyhounds indicates the habitual method of escape of the species from fleet-footed foes, so must one believe that the evasive twist of a butterfly when pursued by a bird is an inherited habit that has proved a means of salvation to members of that species in the past when chased by similar enemies. If, as is maintained, birds do not under natural conditions prey upon butterflies to a sufficient extent to be reckoned as serious enemies, what explanation is to be offered of the marked reaction observable between the two sets of animals when pitted against one another? R. I. POCOCK.

Zoological Society, December 6.

The Weather of 1911.

I HAVE studied with great care and interest Dr. Shaw's letter in NATURE of November 30 disclosing a promising field of inquiry into the causes of such abnormalities of weather as we have, for example, experienced during the summer and first half of the autumn of the present year. Seizing hold of the very fact Dr. Shaw's letter refers to, which has apparently induced him to look in the direction of the upper atmosphere above 9 kilometres for new lines of investigation, namely, that certain types of distribution of barometric pressure, normally rainy, occasioned little or no rainfall in the summer of 1911, I had before reading his letter entertained the idea that somehow or other the persistent, parching drought might have been due to an abnormally reduced *absolute* humidity of the atmosphere (at least of those strata not immediately in contact with surface water supplies) over these islands, so much reduced that the convection currents adequate to produce rain in more normal conditions failed to do so in the present year. I admit, of course, that a decreased absolute humidity of the air in hot summer weather, with the ocean all round us, would be a very different thing to account for, and perhaps could only be brought about by a persistent flow

of the air currents to our region from some arid continental region like the interior of Asia, which would be very unlikely in summer.

But the suggestions embodied in Dr. Shaw's communication no longer render necessary such an assumption as small vapour-content of the air to account for the circumstances of the drought. For I take it that if a barometric depression were transmitted to the surface strata entirely by variations of pressure occurring beyond the convection region at a height of about 9 kilometres, there would not be engendered the powerful rain-producing convection currents usually associated with cyclonic circulation when a barometric depression takes its origin wholly or partly in causes residing in the lower layers themselves.

Should this proposition not follow on the lines indicated in Dr. Shaw's letter, I should be glad if he would correct it. L. C. W. BONACINA.

Hampstead, N.W., December 2.

MR. BONACINA would draw a distinction between barometric depressions transmitted from above and those which take their origin wholly or partly in causes residing in the lower layers themselves, and he would attribute a peculiarly rainy character to the latter. I know of no facts which enable us to draw with certainty the distinction in individual cases, and I should have been glad if Mr. Bonacina had cited some examples which were demonstrably of the second type. I cannot speak very positively on the subject. There is a certain hyperbolic region, sometimes shown on weather maps, between a pair of cyclones and alternating anticyclones where I think such depressions may occur. The weather associations of that particular distribution are peculiar; in the words of a well-known verse:

> When it is good, it is very very good,
> But when it is bad it is horrid.

In summer, thunderstorms with copious rainfall may occur with such a distribution. They are associated with areas of shallow depression—local secondaries—which may be entirely surface-bred; but the pressure differences involved are so slight that they must be regarded as belonging rather to the embroidery than to the outlines of the pressure distribution of the globe.

Let me take the opportunity to add that the further study of the physics of rainfall might contribute to the clearing up of some misconceptions about its meteorological significance. Suppose that we regard rainfall as incidental to convection, that is, to the process of righting instability in the lower or middle layers of the atmosphere, which may be caused by the superposition of layers of inverted density. Consider the effect of variations of pressure imposed entirely from above. If the lower layers contain a stratum of floating cloud, it follows from the difference of adiabatic temperature-change in cloudy and dry air that compression will produce instability at the lower surface of the cloud and rarefaction will produce instability at the upper surface. Alternate compression and rarefaction, such as would be imposed from above if some giant were playing upon the middle and lower layers of the atmosphere, with their cloud strata, like a concertina, would give alternating instability of different types. With one type rain would be produced. What would happen with the other I have not fully made out; perhaps the mammato-cumulus cloud may illustrate it. A good deal depends upon the vertical temperature gradient, of the causes of which at present we know little.

Certainly if there were no cloud layer to form a locus of instability, compression would simply raise the temperature of the air, and hence its potential dryness. The other stroke of the concertina, the rarefaction, might itself produce cloud, possibly at more than one level, and its continuance would maintain the cloud and the instability necessary for continuous, but fluctuating, rainfall if supplies of suitable air were forthcoming. We have here an explanation of cloud layers at different levels and of the well-known tendency towards cloud and rainfall with a falling barometer that is satisfactorily independent of surface conditions. Looking into the details, we can also see that a falling barometer alone is not necessarily a sufficient cause.

Parenthetically, may I express the hope that Mr. Bonacina or some other student of weather will refer to the figures for the dryness of the air of the past summer as compared with air under similar conditions of wind direction, &c., in previous summers? The facts are available and well worth investigation. There is, I have reason to think, a high negative correlation between humidity at 9 a.m. and the duration of sunshine for the day, and this may point to another factor in the cause of the brilliant summer.

I hope Mr. Dines will make good his view that the distribution of temperature in the upper layers is not related to the direction of the air currents. When I wrote I had in mind particularly a cold invasion in the upper air of July 29, 1908, with a northerly wind, and the apparent increase in intensity of the phenomena of a line squall at higher levels. But if we can be assured that cold invasions begin at the bottom, it will free us from much difficulty.

In the interesting letter from Dr. Carl Ramsauer published in your issue of December 14 the argument is based upon the assumption that during the past summer condensation in the atmosphere was inhibited for want of nuclei. The assumption requires proof before it can be accepted as a basis of physical reasoning. Supersaturation of air in the free atmosphere is often assumed, but, so far as I know, it has never been demonstrated, and meteorologists, as a rule, do not feel themselves at liberty to use it. W. N. SHAW.

December 19.

THE contributions in your columns to this subject are of great interest. I will venture, with your permission, to propound one or two questions suggested by the letter of Dr. Carl Ramsauer. On his hypothesis, would it not follow that all periods of minimum solar activity would be marked by weather of the 1911 type? Is this the case?

On the same assumption, it would seem to follow that the same type of weather would extend over the whole earth: has this been the case? We have, I think, heard of torrential rains in northern Italy in the beginning of summer, and of the early onset of winter in Canada.

Again, assuming this hypothesis, not the earth only, but all the planets would have been affected. Have the supposed snow-caps of Mars shown any shrinkage?

Failand, December 15. EDW. FRY.

The Photography of Hα during Solar Eclipses.

IN NATURE for December 7 (p. 182) the report of the council of the Royal Society is said to state that at the total solar eclipse of April 28 the observers sent out by the Joint Permanent Eclipse Expedition secured observations with a short-focus prismatic camera showing the whole of the hydrogen series, with the additional remark that "this is the first time Hα has been photographed at an eclipse."

In the interest of accurate annotation, however, this statement of the council must be modified, as reference to the reports presented to the Royal Society of the eclipse of 1893 (West Africa) and 1898 (Viziadrug) will show that the Hα line was recorded as a strong line on the photographs obtained with prismatic cameras at both these eclipses by the expeditions from the Solar Physics Observatory. It was also recorded by other observers at the Indian eclipse of 1898. CHARLES P. BUTLER.

The Nematodes of the Thames.

REFERRING to my former communication on this subject, I am happy to say that I have at last discovered the host of at least one of the species of nematode found in the Thames. Mr. Chas. Todd, of Tottenham, has kindly sent me a sample of mud from near the Tower Bridge containing vast numbers of Tubificidæ. Among these are *Limnodrilus hoffmeisteri*, *Tubifex campanulatus*, and other interesting fresh- or brackish-water worms. The nematode has so far been found only in Tubifex. It gains an entrance into the spermathecæ, where it develops to the great inconvenience of its host. HILDERIC FRIEND.

Swadlincote.

MICROSCOPE STANDS.

CONSIDERABLE attention is now being directed by those interested in microscopy to various questions connected with the build of the instrument irrespective of the purely optical parts. We have thought it desirable, therefore, to ask the opinions of those with large experience in the designing and production of stands both here and on the Continent. These opinions are given below.

CLAIM FOR SUPERIORITY FOR THE ENGLISH STAND.

By the term "English microscope" is meant the distinctive type of instrument which has been built to embody conveniences for working with modern high-class objectives and condensers, which conveniences cannot be found in combination in any other microscopes than those of British origin. Among them are the following:—(1) *The tripod foot; (2) *a long range of coarse adjustment for the use of low-power objectives; (3) *the body tube fitted with mechanical draw tube to allow for the adjustment of objectives for thickness of cover-glass; (4) the mechanical stage scientifically constructed as a part of the whole instrument; (5) the compound substage with rackwork to focus and screws to render the substage condenser axial with any objective that may be in use; (6) *fine adjustment to substage; (7) *the Wenham binocular body; (8) the various fittings for substage apparatus, eyepieces, and objectives of the Royal Microscopical Society's standard gauge; (9) *all the working parts fitted with sprung bearings and controlling screws so that compensation for wear and tear may be readily effected.

In the English microscope alone are all these conveniences to be found in combination. In isolated instances one or two of the fittings are included in microscopes of foreign origin, but none are provided with those marked with an asterisk, in the manner that is usual in the English instrument.

Numerous microscopes are made in Great Britain which are not of the typical English model, designed for students and special uses, but even in these it is customary to incorporate some of the qualities and conveniences enumerated above, and they permit of greater latitude in individual working on the part of the intelligent user than is possible with a microscope which must of necessity be used as a tool that magnifies on account of its limitations.

The English microscope has never suffered from want of appreciation on the part of those who have had leisure or taken sufficient interest to use its many refinements, and it is significant that it is the prevailing type that is employed by the thousands of amateur workers throughout the world to-day.

To the professional worker it has not appealed in the same degree, but gradually he is appreciating the fact that to do the best he must have the many facilities that the English microscope affords, and it is in consequence gradually displacing instruments of simpler construction.

The English microscope has always been of substantial proportions, but a definite advance in its precision took place when between twenty and thirty years ago it was recognised by the leading exponents of microscopy, and especially Dr. Dallinger and Mr. E. M. Nelson, that the improved optical means then introduced could not be advantageously employed without adequate mechanical conveniences. A slower acting fine adjustment suitable to the increased numerical aperture of objectives was the earliest step, and after many years' insistence that the now almost extinct direct-acting fine adjustment was sufficient for all requirements, the Continental makers fell into line with the English makers.

Then followed the mechanical draw tube, and only those who have seen the beautiful manipulative effects obtained by leading workers, can realise what can be done by its use in correcting for slightly different thicknesses of cover-glass. It has been stated that a difference of draw-tube length of 5 mm. is of no practical importance, but this is not the experience of the modern worker. His critical effects are obtained within closer limits.

Improvements were simultaneously introduced into the general design of microscopes, refinements which advanced workers found desirable were incorporated, and British manufacturers produced instruments which are to this day known by the name of the microscopist who provided the specification.

The result has been that the English microscope is a distinctive one, and is unlike its contemporaries of other countries in several important features.

The mechanical stage of the English microscope, built as part of the instrument, has very forcibly revealed its advantages in connection with the recent introduction of immersion paraboloids and reflecting condensers. The attachable mechanical stage of the Continent carries the object slip along the surface of the stage. For these immersion paraboloids it is essential that the under-side of the object slip shall be in contact, by means of immersion oil, with the top lens of the paraboloid. It will be obvious that as the mechanical screws carry the object slip along the surface of the stage the oil from the under-side of the object slip will pass on to the stage surface. The immersion oil is thus drawn away and the contact is no longer maintained. The same effect is produced with any immersion condenser, so that in effect the attachable form of mechanical stage largely interferes with the proper working of any condenser or paraboloid which may be of the immersion type.

It should be borne in mind in this connection that the Abbe illuminator, if used in its full efficiency, must be immersed. This fact is generally overlooked, and it is exceedingly rare for an Abbe illuminator to have its maximum numerical aperture developed by means of oil immersion.

The English mechanical stage has each plate working independently, and the object is carried in a fixed position on the top moving plate. The oil therefore does not run on to the stage surface as in the pattern just mentioned.

The compound substage is typically English. The necessity for centring screws to enable the optical centre of the substage condenser to be adjusted to the objectives in use has to this day not been recognised by Continental opticians.

A fine adjustment to the substage was the accompaniment to the more general use of the oil-immersion condenser, the absolute focussing that this required being realised better by this means than by coarse adjustment only.

There is still want of conformity with the Royal Microscopical Society's substage size on the part of non-British makers, and the condensers are not interchangeable without alteration.

The advantages associated with the tripod foot which, properly proportioned, is light in weight, and yet imparts rigidity which is not possessed by any other shape, the convenience of being able to use low-power objectives, and the Wenham's binocular body with its exquisite stereoscopic effects, and, finally, the obviously better construction from a mechanical point of view of fittings that are adjustable in consequence of wear, all unite to make the British microscope an instrument of precision.

It is admitted that many of the refinements which are referred to here are of but small use to the man who does not make himself acquainted with elementary principles of microscopical theory and manipulation; but any worker who intends to wrest from his instrument the best it is capable of yielding and desires to make himself proficient in its use will find that the English microscope must be employed.

A Defence of the Continental Form.

The Continental microscopes are of a shorter build than the original English pattern, and are normally supplied with a tube length of 160 mm. (6 inches), while the English tube length normally supplied is 250 mm. (10 inches).

The short Continental microscopes are more convenient to use on a table of normal height, and, owing to their compactness and portability, are mostly used in laboratories of universities, institutions, &c., in this country.

The equipment of these microscopes varies considerably, and the better microscopes of the leading makers are fitted with all the modern appliances demanded with an up-to-date fully equipped microscope.

The stands are often fitted with mechanical stages of exquisite design and large opening, being revolvable, and having a displacement for the cross motion large enough to allow for searching over an entire slide; they are very convenient if serial slides are to be examined. Verniers are provided to locate the exact position of the object, thus saving a great deal of time in finding the exact spot noted on any previous day.

The substage arrangement is of the usual Abbe form, with sliding sleeve to receive either a fixed ordinary Abbe condenser or an achromatic condenser with centring device.

The iris diaphragm carrier on the substage is of a very ingenious construction, being provided with rackwork to place the iris out of centre, up to a range to meet the extreme margin of a numerical aperture of 1·40, and, owing to the iris diaphragm carried being revolvable around the optical axis of the microscope, specimens can be illuminated from any azimuth and obliquity with the greatest ease.

The recess in the iris diaphragm carrier takes a polariser, also mica films, in a convenient manner should the microscope be used with polarised light.

The complete substage with condenser is provided with a rack and pinion work, and the best make acts with such precision, having no back-lash whatsoever in the rack and pinion movement, that the fine adjustment of the substage is absolutely superfluous.

The horseshoe foot, provided with three resting points on the extremity of the horseshoe, has been much improved of late in order to ensure great firmness of the stand for visual observation. For horizontal use, as is the case in photomicrography, the Continental models are chiefly used with a suitably prepared sole plate with levelling screws and clamping device; this mode has also proved to be of great service even with the larger tripod stands of best English make.

The body tube of some of the Continental stands are exceptionally wide in order to allow the use of low-power objectives without cutting down the field, and also to avoid internal reflection.

The fine adjustment is placed near the stage in the most convenient position, and is of the greatest sensitiveness, an interval on the scale representing a movement of 2/1000 of a millimetre. The rackwork is sufficiently large to meet even low powers of 4-inch focus.

All important sliding parts are not sprung but carefully ground in and free from back-lash, which is essential if the microscope is expected to remain in focus, chiefly with high powers. Sprung motions, however carefully done, are bound to counteract.

First-class Continental makers do not spare expense in making these carefully ground-in sliding parts, and this is the best and surest manner to guarantee a first-class microscope to be steady in focus. With the cheaper Continental models the sprung sliding sytem is used to some extent, but less accuracy in this motion is required with such microscopes, which are chiefly designed for low powers.

For binocular vision, even with oil-immersion lenses, the Abbe stereoscopic eyepiece of latest form is simply unique.

To sum up the advantage of the Continental model, it is only fair to say that the instruments, though simple in construction, are certainly most efficient for the highest class of research work in microscopy.

English and Continental Microscopes.

The average English microscope of the present day is a representation of a simplified instrument of what in former days presented a complicated and massive piece of mechanism. The Continental model, on the other hand, has gradually been evolved from an exceedingly simple design to an efficient and practical instrument better adapted to the requirements of the serious worker than is the typical English model possessing the multiplicity of racks and screws and milled heads so much admired by a certain class of dilettanti. The serious worker in science has not the time to play with the large variety of unnecessary fittings embodied in the typical English microscope, while the dilettante finds a whole day may be well spent in a variety of manipulations effecting mechanical and optical adjustments (mainly mechanical) to enable him to examine only a few objects, and such a day's work often proves to be more exhausting physically than mentally.

The tripod base is more rigid than the typical Continental "horseshoe" base, but of recent years the leading Continental makers have so modified the "horseshoe" in that the "toes" are spread outwards and the "heel" prolonged to an extent that the instrument is sufficiently rigid for all practical purposes. When using the microscope in the horizontal position for photomicrography the tripod base gives greater rigidity when not fixed by screws or clamps to the photographic apparatus, but it is not wise to employ the microscope in photomicrographic work without having it securely clamped to the base plate of the apparatus, and therefore in this respect the Continental "horseshoe" is equal to the English tripod.

There are Continental microscopes made with "horseshoes" giving equal rigidity in vertical and horizontal positions to the tripod, and possessing the great advantage of free access to the substage, a feature generally lacking in the typical English model.

The substage with centring arrangement is rarely met with in Continental models, but instead, centring adjustment is provided in the nosepiece, which is undoubtedly a more accurate method of obtaining optical alignment than by displacing the condenser to suit a change of objective. Indeed in photomicrography the absence of centring screws in the substage means a considerable saving of time and greater accuracy is obtained by employing centring screws, or the Continental objective sliders, attached to the body tube of the microscope.

As regards the stage: at one period the principal difference existing between the two makes was that the Continental was provided with an attachment giving mechanical motion, while the English mechan-

ical stage formed an integral part of the instrument. Now we find a "built in" mechanical stage in the best Continental microscopes, and they, as instruments of precision, are of a higher order than is obtained in the English models.

The fine adjustments in the Continental models are made in a variety of patterns, but in their best form we have as yet nothing in this country to compare in quality of mechanism and slowness of motion.

The mechanical draw-tube is provided in only a few Continental models, a feature more common in the English. Instead of this adjustment the Continental makers provide the objective with correction collars to allow of adjustment for varying thicknesses in cover glasses, and this is considered more accurate than the mechanical draw-tube.

It is often claimed by English makers that one of the advantages in possessing an English microscope is that certain fittings are made to the Royal Microscopical Society's standard measurements. As regards objectives and eyepieces there is little or no difficulty in getting the products of all reputable makers interchangeable, whether English or foreign; but a different state of affairs prevails in respect to substage sleeves, for it is generally found that not only does one English maker's condenser refuse to fit into the substage of another, but it is a common fault to find substage sleeves of English microscopes varying so much in diameter that the ideal of R.M.S. standardisation has yet to be reached.

Neither the society nor the makers have met the needs of English microscopists in this respect, so it may be left to the National Physical Laboratory to step in and fill the gap, which is a wide one.

Sprung fittings is another feature claimed for certain English models, yet a curious contrast is shown respecting the durability of these adjustments as compared with the Continental.

The screwdriver is a tool frequently used by owners of the former class of instrument, while the leading Continental instruments require adjustments only once in many years of daily usage.

Accordingly it would appear that fewer sprung fittings add to the durability of the instrument.

When choosing a microscope to embody the greatest possible facilities for the present-day needs of the serious worker, it will be found to be a product of one of the best German houses.

SLEEPING SICKNESS AND BIG GAME.

IN spite of the fact that a commission has been sent out to Nyasaland to investigate the problem of the relations of the big game to the spread of sleeping sickness, under the direction of Sir David Bruce, the most eminent authority on this subject in this or any other country, persistent efforts continue to be made to force the Colonial Office to prejudge the issue and to cause the game to be exterminated before its relation to the disease has been determined accurately. The latest of these efforts was made in the House of Commons on December 13, by Dr. Chapple, member for Stirlingshire, who urged the Secretary for the Colonies to relax the severity of the game laws so as "to permit of the natives hunting *game known to harbour the trypanosome in their blood* in order that both the *game and the infecting fly which invariably accompanied it* might be driven off from the populous centres." We have italicised two statements in Dr. Chapple's speech, as reported in *The Times* of December 14, in order to direct attention to points in which scientific knowledge at the present time does not confirm, or is at variance with, the grounds on which he bases his plea for extermination. His argument is but another instance of the lamentable ignorance of our legislators in scientific matters.

The question under consideration has been discussed at some length in the last three numbers of NATURE, and it will be sufficient here to summarise briefly the present position of the problem. The extermination of the game is urged by its advocates on the following grounds:—(1) That antelopes and other wild animals harbour *Trypanosoma gambiense* in their blood, and are therefore dangerous as a source of infection; (2) that the tsetse-flies instrumental in the transmission of sleeping sickness are dependent upon, and accompany, the big game, and would disappear if the game were destroyed.

With regard to the first point, it has never yet been shown that the big game, in a natural state, harbours the trypanosome in its blood, but only that antelopes can be infected with *T. gambiense* in the laboratory; and this has been shown also for *practically all the common domestic animals*. It may be left to common sense to judge whether, in a region in which the tsetse-flies abound, the domestic animals surrounding the villages and homesteads, or the shy and timid antelopes keeping their distance in the jungles, are likely to be the greater danger to human beings as a source of infection.

With regard to the second point, those who are acquainted with the tsetse-fly in its native haunts are by no means agreed that it is dependent on big game, or that it necessarily accompanies it; on the contrary, many instances have been adduced of tsetse-flies swarming in places where there is no big game of any kind. If, however, it were admitted for the sake of argument that the flies follow the big game, what effect is likely to be produced by the destruction of their natural food? Is it to be supposed that the flies would sit down and die helplessly of starvation? Is it not far more likely that they would be attracted by the food supply offered by the domestic animals surrounding the homesteads, animals which almost without exception are potential hosts of the trypanosome just as much as the big game? If such an effect were produced, the danger to human life might be increased tenfold.

The whole question is one beset with dangers and difficulties, calling for full investigation of the complex factors of the case and for the utmost caution before proceeding to take action. To carry out the extermination of the game in the present state of our knowledge would be simply a leap in the dark, an experiment which, so far as can be foreseen, would lead to no amelioration of the conditions, but might, on the contrary, be fraught with disastrous results. The Colonial Secretary must be commended for having refused, so far, to allow his hand to be forced in the matter. The wisest course in the circumstances is surely to "wait and see" what are the conclusions reached by Sir David Bruce's Commission.

EXPLORATION IN THE DEPARTMENT OF PETEN, GUATEMALA.[1]

THE ruins of Tikal, completely hidden in the forest in the northern part of Guatemala, distant about thirty miles from the Lake of Peten, and forty miles from the nearest habitation, are among the most important and interesting in Central America.

Since my second visit to these ruins in 1882, I have been anxiously awaiting the result of further explorations on this attractive site, and at last it has come in a handsome volume published by the Peabody

[1] Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. v., Nos. 1 and 2:—"Explorations in the Department of Peten, Guatemala: Tikal," by Teobert Maler; "Preliminary Study of the Ruins of Tikal, Guatemala," by A. M. Tozzer. Pp. 135+28 plates+2 maps. (Cambridge, U.S.A.: The Museum, 1911.)

Museum of Harvard University, under the auspices of which the explorations were undertaken. The first and

FIG. 1.—View from Temple No. 1 looking west.

second of these expeditions were conducted by that veteran explorer, Mr. Teobert Maler, and the third by one of the most prominent of the younger generation of Americanists, Dr. Alfred M. Tozzer. Owing to some unfortunate friction between Mr. Maler and the Peabody Museum, Mr. Maler's plan of the ruins and some of the detail plans of the buildings he describes were not obtained for this volume, and it is therefore difficult to do full justice to his share of the work.

During Mr. Maler's preliminary expedition (1895) he remained only eight days at the ruins. On his next expedition (1904) he was camped there for four months, from August to November. As these are the rainy months, he certainly avoided the great difficulty attending a residence at Tikal during the dry season, which is the scarcity of water; on the other hand, four months' camping in a tropical forest during the rains must have entailed great hardship, and it must often have been very difficult to carry on any work at all.

It is to be regretted that Dr. Tozzer's report is not accompanied, as is Mr. Maler's, by a personal narrative; moreover, he gives no indication of the length of his stay at the ruins. Personal narrative may be of no particular scientific interest to the archæologist, but it is of the greatest value to future explorers to know what difficulties have to be overcome and how much work can be accomplished within a specified time.

Mr. Maler discovered a considerable number of hitherto unknown sculptured stelæ, and both his report and Dr. Tozzer's are furnished with many detailed plans of buildings.

Dr. Tozzer was accompanied by Mr. Merwin, who observed the azimuths of the front and back walls of the five principal temples with a transit instrument, but the sketch plan printed in this volume does not show the buildings plotted according to these bearings, and although it shows much that was previously unrecorded, a more accurate survey of the site is to be desired; in fact, although the work accomplished by Mr. Maler and Dr. Tozzer adds considerably to our knowledge, much yet remains to be done at Tikal.

Dr. Tozzer does not say whether he made paper squeezes of the carvings and inscriptions, but it is to be hoped that moulds were made, for, excellent as Mr. Maler's photographs are, photographs alone do not suffice for a careful study of the carving, and plaster casts are absolutely necessary.

Mr. Maler says that Tikal covered an area of four to five kilometres square, but surely this requires verification by further measurements. Dr. Tozzer's sketch map, which includes all the buildings described in the reports, measures less than $1 \times 1\frac{1}{4}$ kilometres. Isolated buildings may be found at a distance of two kilometres from the centre of the city, but this does

FIG. 2.—Circular Stone Altar at Tikal.

not prove that the city proper covered such a great area as Mr. Maler states.

To those who have not studied American archæology, it is a surprise to learn that the remains of a city covering nearly a square mile, with five great stone-built temples, raised on pyramidal foundations, the highest reaching an elevation of nearly two hundred feet from the ground, as well as many smaller temples of similar form, and well-built stone houses containing numerous small, stone-roofed chambers, are to be found hidden away in the depths of a tropical forest in America. However, American archæology is still in its infancy, and may have some strange developments in store for us; it is a vast field, and as the interest in it is rapidly increasing, there is every hope that the rising enthusiasm of students and explorers will result in dispelling much of the mist which obscures the curious civilisations, some of which developed and waned many hundreds of years before the first Spaniard set foot on the American continent. Mr. Maler probably closes a long career of exploration in the forests of Guatemala and Yucatan with his last journey to Tikal, but from Dr. Tozzer one can happily look for useful and conscientious work, both in the field and in the study for many years to come.

ALFRED P. MAUDSLAY.

THE ECOLOGY OF DESERT PLANTS.

IN a publication of the Carnegie Institution of Washington, entitled "The Water-Balance of Succulent Plants," Mrs. E. S. Spalding adds to the statistics that she had previously given concerning the reversible changes in dimensions and form of *Cereus giganteus*, the massive stem of which acts as an expanding and contracting water-reservoir. Her observations on the rate of growth of this "giant cactus" lead to the conclusion that it requires a hundred years to attain a height of ten metres. Mrs. Spalding shows that analogous reversible change in volume takes place in *Echinocactus Wisliz-e-ni*, and *Opuntia* spp., and gives the interesting information that the former, at first spherical in form, becomes irregularly columnar, lop-sided, and top-heavy, so that it readily topples over or is uprooted by the wind. She suggests that the inefficiency of the root-system thus revealed represents a case of incomplete adaptation, which accounts for the "sparse occurrence" of the plant.

FIG. 1.—*Cereus giganteus* having a dead trunk and living branches which bore flowers one year after the death of the trunk.

By the somewhat cryptic and certainly inelegant expression "water-balance," Mrs. Spalding and her co-author, Prof. D. T. Macdougal, mean the amount of water stored in the plant. The latter author's contribution to the work includes statistics as to the rate and amount of loss of water of certain succulent plants, including the three species mentioned above; for instance, he concludes that individuals of *Cereus giganteus* "12 to 20 metres in height would contain from 2000 to 3000 litres of water," and that "such individuals might lose from 1000 to 1600 litres of water . . . and still survive." As an excellent example of the power of endurance displayed by this species under net loss of water, Prof. Macdougal mentions that branches may remain alive and even bear flowers many months after the death of the main trunk. A number of successful photographs illustrate the work, and one of these is reproduced here.

SIR JOSEPH DALTON HOOKER, O.M., G.C.S.I., F.R.S.

THE most distinguished son of a very distinguished father, Joseph Dalton Hooker was born at Halesworth, in Suffolk, on June 30, 1817. Early in 1820 his father was appointed by the Crown to fill the chair of botany in the University of Glasgow, a post which he held until, in 1841, he became director of the Royal Gardens at Kew. As a consequence Hooker was educated in Glasgow, passing through the High School to the University, from which he obtained the degree of M.D. in 1839. Devoted as a lad to the reading of works of travel, we learn from Hooker himself that he was especially impressed by Turner's description of the Himalayan peak of Chumlari, and by the account of the Antarctic island of Kerguelen contained in Cook's voyages. An opportunity of investigating the latter came to him very early in his career. When he completed his medical studies, Hooker entered the Royal Navy as an assistant surgeon, and was gazetted to the *Erebus*, then about to start, along with the *Terror*, on the famous Antarctic expedition led by the eminent navigator Sir James Clark Ross. Throughout this expedition the young assistant surgeon held the post of botanist, and during its three years' cruise in the southern seas he was able to visit New Zealand, Australia, Tasmania, Kerguelen, Tierra del Fuego, and the Falkland Islands, amassing large collections and acquiring a vast amount of botanical information.

Shortly after the close of this expedition, Hooker, in 1843, became assistant to Graham, then professor of botany in the University of Edinburgh, and in 1845, when Graham was succeeded by the elder Balfour, Hooker was appointed botanist to the Geological Survey of Great Britain. Much of his time during this period was devoted to the preparation for publication of the results obtained during the course of his Antarctic voyages. But in 1847 this work was temporarily suspended, and his appointment on the Geological Survey was relinquished, in order that Hooker might add, by further travel, to his first-hand knowledge of the vegetation of sub-Antarctic and temperate regions, a corresponding acquaintance with the botany of tropical countries. The region selected was north-eastern India, then a practically unexplored tract. The undertaking, originally designed as a private enterprise, through a series of happy accidents received official recognition, and the expenses involved were to a partial extent met from public funds. Hooker left England in November, 1847, reaching India in January, 1848. After some three months spent in the Gangetic Plain and Behar, during which he ascended the sacred hill of Parasnath, Hooker made his way to the Himalayas, reaching Darjeeling in Sikkim in the middle of April. The next two years were devoted to the botanical exploration and topographical survey of the Himalayan state of Sikkim and of a number of the passes which lead from that

country into Tibet; if he did not actually reach he at least had opportunities of seeing the noble peak of Chumlari, which had helped to fire his youthful ambition to become a great traveller. Towards the close of the year 1848 Hooker had an opportunity, which has come to no one since, of crossing the western frontier of Sikkim and exploring a portion of eastern Nepal. During the greater part of the time spent in the eastern Himalayas, Hooker travelled and surveyed alone, but in October, 1849, he was joined by Dr. Campbell, the superintendent of Darjeeling, who had obtained official authority to visit Sikkim. Shortly after Campbell joined him, the Sikkim authorities seized the opportunity thus offered to imprison and maltreat Campbell, at the same time confining Hooker, whom, however, they refrained from injuring. The captives were released towards the end of December, 1849, and the next three months were spent by Hooker in arranging at Darjeeling his vast collections.

Early in 1847 Dr. Thomas Thomson, of the Indian Medical Service, son of a colleague of the elder Hooker in the University of Glasgow, and an old classmate and intimate friend of his own, had been deputed by Lord Hardinge to visit and report upon certain portions of the western Himalaya and Tibet. This mission completed, Thomson made his way to Darjeeling in order to join Hooker, and the year 1850 was devoted by the two friends to the botanical investigation of eastern Bengal, Chittagong, Silhet and the Khasia Hills.

On his return to England in 1851 Hooker resumed the task of publishing his Antarctic results, and began, in conjunction with Thomson, to elaborate those of the Indian journeys. The collaboration of the two friends in the preparation of a "Flora Indica," the first and only volume of which appeared in 1855, ceased when Thomson returned to India, and the appointment of Hooker in that year to the post of assistant director at Kew under his father brought with it duties more than adequate to occupy the time and attention of an ordinary official. The performance of these duties, however, did not impede his Antarctic studies, and in 1860, which saw the completion of the great work on the botany of the Antarctic voyage, Hooker was able to add still further to his extensive knowledge of topographical botany. In the autumn of that year he was asked by Captain Washington, hydrographer of the Royal Navy, to take part in a scientific visit to Syria and Palestine. In the course of this journey he ascended Lebanon and investigated the history, position, and age of the cedar grove which has made that mountain a household word, but of which until then nothing was accurately known.

On the death of the venerable Sir William Jackson Hooker in 1865, Hooker was appointed director of the Royal Gardens, Kew, in succession to his father. This position he held during the next twenty years. The engrossing work and added responsibilities of this period did not, however, prevent Hooker from taking his full share of those public duties which naturally fall to the lot of men of his eminence. He presided over the thirty-eighth meeting of the British Association held at Norwich in 1868, and over the Department of Zoology and Botany in the Biological Section at the meeting held at Belfast in 1874. In 1873 he undertook the arduous duties of president of the Royal Society, and occupied the presidential chair for the next five years. Nor did these duties entirely debar him from further botanical travel. In 1871 he undertook, in company with the late Mr. Ball and Mr. G. Maw, a botanical expedition to Morocco and the Atlas range; in 1877, in company with his intimate friend, Dr. Asa Gray, and with Dr. Hayden, of the United States Survey, he took part in an important botanical journey to Colorado, Wyoming, Utah, the Rocky Mountains, the Sierra Nevada, and California.

From the time of his retirement in 1885, Hooker's life was spent at The Camp, near Sunningdale, where he had built for himself a home, the grounds of which, furnished with all the advantages that knowledge and taste can provide, contain one of the most interesting collections of plant forms in this country. Here he devoted himself with the energy and enthusiasm of one commencing his career to the completion of tasks already in hand and to the initiation of new ones. His critical acumen, which remained unaffected by advancing age, and his physical vigour, which became seriously impaired only a few weeks before his death, enabled him, in the freedom from administrative duties which retirement had brought, to accomplish work which as regards its amount must be considered the ample harvest of a lifetime, and as regards its quality, and no higher tribute could well be bestowed, fully sustained the reputation of his earlier publications.

The work which Hooker accomplished can be but briefly outlined here. Space forbids a complete enumeration of his many contributions to natural knowledge; all that can be done is to endeavour to indicate the various lines of his intellectual activity, and to note how these were affected by the leading events in his personal history. While still an undergraduate, Hooker had been at work in his father's herbarium in Glasgow. The earliest of his results appear in a paper on Indian mosses, written in collaboration with the late Prof. Harvey, which was published in 1840, shortly after he had joined the expedition under Ross. Work connected with cryptogamic plants was one of his strongest early inclinations, for some of the most important of his papers, prepared during the years 1844 to 1847, when he had returned from the Antarctic, deal with the hepatics, lichens, mosses, and algæ of the southern circumpolar regions. But a predilection for work on fossil botany manifested itself almost as early in his career; another early paper, written and published in 1842, while still botanist on the *Erebus*, deals with an examination of a Tasmanian fossil wood. As his general work on the Antarctic material he had accumulated made progress, we find, however, that his cryptogamic work came to be done more and more in collaboration with workers who had made some particular lower group their special province. The botanical results of the Antarctic voyage occupy six quarto volumes subdivided into three sections: (1) the "Flora Antarctica," completed in 1847, before he left for India; (2) the "Flora Novæ Zelandiæ," issued in 1853, after his return from the East; and (3) the "Flora Tasmaniæ," published in 1860, after he had become assistant director at Kew.

But the preparation of the first section of the Antarctic work did not impede his activities while connected with the Geological Survey between 1845 and 1847. Before undertaking the duties of the post he had already given attention to problems connected with fossil botany; while attached to the Survey he prepared during 1846–7 several important papers on the subject, the most notable of these being a discussion of the vegetation of the Carboniferous period as compared with that of the present day, which was printed in 1848. But his interest in the subject did not end with the severance of his connection with the Geological Department; two interesting papers on fossil botany from his pen were published in 1855. After his appointment as assistant director, however, he made no further formal contribution to knowledge in this particular field. His Antarctic work and his

duties in connection with the Geological Survey did not, however, suffice to occupy all his time prior to his departure for India. He drew up an "Enumeration of the Plants of the Galapagos Archipelago," issued in 1847, and collaborated with the late Mr. Bentham in preparing the "Flora Nigritiana," incorporated by Sir W. J. Hooker in the "Niger Flora," published in 1849.

Some of the results of Hooker's Indian observations, notably those relating to his journeys in the Indian plains, were published by the Asiatic Society of Bengal in 1848. But if on his return to England in 1851 he reverted with energy to the elaboration of his Antarctic results, the Indian material was not neglected. He began, in collaboration with Thomson, that "Flora Indica" the issue of which in 1855 has already been alluded to. In connection with this work two sumptuous illustrated folios were issued; the first, on "The Rhododendrons of the Sikkim-Himalaya," was edited from Hooker's notes, sketches, and material, by his father, between 1849 and 1851; the second, "Illustrations of Himalayan Plants," chiefly made for an Indian friend, Mr. Cathcart, in the Darjeeling neighbourhood, was edited, with descriptions by Hooker himself, in 1855.

This was, however, by no means all that he was able to accomplish. In addition to the families formally described in the solitary volume of their "Flora Indica," Hooker and Thomson discussed in the Linnean Society's Journal various problems of interest relating to individual Indian plants, and issued a series of papers, "Præcursores ad Floram Indicam," dealing more completely with a number of important natural families. Finally, Hooker's "Himalayan Journals," one of the most fascinating books of travel in our language, in which his Indian journeys are dealt with generally, was issued in two octavo volumes in 1854. Probably no botanical field work has proved more fertile in interest or provided material of greater value in the discussion of biological and phytogeographical problems than that done by Hooker. Yet great as were his botanical results and pardonable as it is in the botanical worker to look upon these as Hooker's highest achievement, it is doubtful whether the topographical results were not of even greater moment. These results, reduced by Hooker himself, with the assistance, as he tells us, of various Anglo-Indian friends who came under the magic spell of his personality, were arranged at Darjeeling during the early months of 1851. They formed the basis of a map, published by the Indian Trigonometrical Survey, with the aid of which, such is its accuracy and its detail, the operations of various campaigns and political missions have been carried to a successful issue.

The ten years during which Hooker was assistant director at Kew were marked by extraordinary activity. The time that could be spared from executive duties was far from being entirely absorbed in Antarctic and Indian work. In 1862, and again in 1864, he dealt with important collections of plants from Fernando Po and the Cameroons in papers valuable in themselves and in the evidence they afford that his interest in the flora of the Dark Continent, first evinced in 1847, had never abated. This interest showed itself once more in a paper of 1875, which may be mentioned out of sequence, on the subalpine vegetation of Kilimanjaro. In this case, however, the interest was associated with another which had guided much of his Antarctic study and had manifested itself in 1856 and in 1861 in dealing with the Arctic plants collected during the Franklin searches and the McClintock expedition. The problems involved were dealt with in a comprehensive fashion in 1861 in Hooker's classic, "Outlines of the Distribution of Arctic Plants." A group of kindred problems had presented themselves to Hooker when engaged in the study of the vegetation of the more outlying Antarctic and sub-Antarctic islands, and subsequently when dealing with the plants of Galapagos. To this period therefore we may most properly ascribe the formation of the views enunciated in a notable discourse on "Insular Floras," delivered at the meeting of the British Association at Norwich in 1866. Yet another allied group of problems called for consideration in connection with his Antarctic, Indian, and African studies; his conclusions with regard to these are stated in his "Introductory Essay to the Flora of Tasmania," published in 1860; the opinions there expressed on the origination and distribution of species suffice to explain the action which Hooker took when, in conjunction with Lyell, he had induced Darwin, in 1858, to publish a preliminary sketch of his famous hypothesis.

To the same period of his activities belongs the share taken by Hooker between 1858 and 1864 in the preparation of Thwaites's enumeration of the plants of Ceylon. To this period we owe, moreover, the codification of the results given in the second portion of the Antarctic flora in the form of a "Handbook of the New Zealand Flora," contributed to the series of Colonial floras published under Government authority. The work was issued in part in 1863; the concluding portion was published in 1867, shortly after the period had come to an end. But to this period we owe, in addition, various important special studies on the structure and affinities of Balanophoreæ, published in 1856; on the origin and development of the pitchers of Nepenthes, in 1859; and on *Welwitschia,* in 1863. The most obvious result of Hooker's visit to Syria in 1860 is a paper on the cedars of Lebanon, Taurus, Algeria, and India, published in 1862. In this article a subject of great interest and considerable difficulty is handled with masterly skill. But the journey bore further fruit in the form of a singularly pleasing sketch of the botany of Syria and Palestine, contributed in 1863 to "Smith's Bible Dictionary." Extensive and important as these various contributions to botanical knowledge are, they do not include all that Hooker accomplished while assistant director; the most onerous and important undertaking initiated during this period has still to be mentioned. In renewed collaboration with Mr. Bentham was commenced one of the outstanding botanical monuments of the nineteenth century, in the form of a great "Genera Plantarum"; of the three volumes which this work includes the first was completed in 1865.

Hooker's succession in that year to the directorship of Kew brought with it all the responsibilities connected with the administration of that national institution. These, however, did not prevent him from continuing to take his share in the preparation of the "Genera Plantarum," the second volume of which was completed in 1876, the third and concluding one in 1883. The directorship, however, brought with it the duties of continuing the *Botanical Magazine* and the *Icones Plantarum,* edited by his predecessor. These duties Hooker continued to fulfil even after his retirement in 1885; in the case of the *Icones* until 1889, in that of the *Magazine* until 1902, and with the collaboration of Mr. W. B. Hemsley for two years longer, his connection with this historic serial ending in 1904, with the completion of the one hundred and thirtieth volume. The death of his father imposed on Hooker yet another filial duty of the most arduous character, that of replacing in 1870, by his own "Student's Flora," the "British Flora" of his predecessor. In 1873 he annotated and rearranged the natural families of plants in an English version of the "Traité général" of Le Maout and Decaisne, and in 1876 he wrote for the series of science primers that on "Botany."

The results of Hooker's journeys in North Africa in 1871 are given in "A Journal of a Tour in Marocco and the Great Atlas," written in collaboration with Ball and published in 1873; those of his visit to North America in 1877 were summarised by himself in our pages (NATURE, vol. xvi., p. 539).

Of the addresses and discourses delivered by Hooker during this period that on "Insular Floras" of 1866 has already been alluded to. That delivered from the president's chair to the British Association in 1868, with its whole-hearted advocacy of an acceptance of the hypothesis of Mr. Darwin as the surest means of promoting natural knowledge, was perhaps more important in its effect on scientific thought generally. His British Association sectional address of 1874, on "The Carnivorous Habits of Plants," was an illuminating review of those problems to which his own observations and researches on Nepenthes in 1859 had directed attention.

It has recently been remarked that "so broad-based were the foundations of Kew as laid by Sir William Hooker that they have been but little extended by his followers. Their work has been to build a noble superstructure. Viewed in detail Kew is hardly anywhere the same as it was in 1865. But the framework is very much the same." These remarks are so just that no useful purpose could be served by any attempt to enumerate here the various manifestations of Hooker's activity as an administrator, or to detail the alterations and additions which marked his directorship. That activity, as was said in this journal by Prof. Asa Gray in the article on Hooker in our "Scientific Worthies" series (vol. xvi., p. 538), was exercised "in such wise as to win, along with national applause, the gratitude of the scientific world." Nor is more than a passing allusion due to a bitter controversy in 1872, Hooker's unsought share in which the world of science made its own. Those whose curiosity extends to the unedifying may find the details in a parliamentary paper; it is sufficient to remark that in the following session the Royal Society chose Hooker to preside over their councils.

We have yet to allude to what was the heaviest and the most prolonged task of Hooker's life, the publication of the "Flora of British India." During his collaboration with Thomson, prior to 1855, in the elaboration of the results of their Indian journeys, the two friends had been able to render available for scientific study the botanical treasures preserved in the East India House. The heavy but essential task of distributing these involved as a corollary the preparation and issue of a catalogue of the specimens dealt with. This catalogue Hooker was able to publish in 1865. A similar necessity subsequently arose in connection with the Peninsular Indian herbarium brought together by the late Dr. Wight. This subsidiary distribution was completed and the requisite ancillary catalogue was prepared by 1870. The task of preparing for British India a flora on the lines of those written at Kew on behalf of the various colonies could at last be undertaken. This task was at once begun; the opening part of the initial volume appeared in 1872 and the volume was completed in 1875. It was followed by the second volume, finished in 1879, by the third, finished in 1882, and by the fourth, the concluding part of which was issued, just as Hooker retired, in 1885.

Nearly half of the gigantic task had still to be accomplished, so that in Hooker's case retirement, if it brought relief from administrative cares, did not bring leisure. The heavy labour was faced without flinching; the progress of the work remained unchecked. The fifth volume, containing four parts, was completed in 1890; the sixth, also a volume of four parts, in 1894; the seventh and concluding volume appeared in 1897.

In the meantime, however, Hooker undertook a new and onerous task. Shortly before his death the late Mr. Darwin informed Hooker of his intention to devote a considerable sum to be expended in providing some work of utility to biological science, and to arrange that its completion be assured should this not be accomplished during his lifetime. The difficulties which he had experienced in his own studies led Darwin to suggest that this work might take the form of an index to the names, authorities, and countries of all flowering plants. At Darwin's request the direction and supervision of the work was undertaken by Hooker; the actual preparation was entrusted to Mr. B. D. Jackson. The result is the "Index Kewensis," of which the publication alone occupied the period from 1892 to 1895. During the period devoted to its preparation and publication the work received the unremitting care and attention of its director and its compiler. Other works, however valuable they may be, admit, as a rule, of some relative estimate. To the "Index Kewensis" no such mode of judgment is applicable; it is simply invaluable, and stands a lasting monument to the wisdom and generosity of Darwin, the piety and sagacity of Hooker, the care and fidelity of Jackson. While this "Index" was in progress, Hooker arranged for publication in 1895 a century of drawings of orchids, for which he provided descriptions, from among the manuscript figures placed at his disposal by the Calcutta herbarium in connection with his own work on the "Flora of British India." Scarcely had the responsibility attaching to the preparation of the "Index" been laid aside ere Hooker undertook, as an act of justice to the memory of a distinguished predecessor, to edit the "Journal of the Right Hon. Sir Joseph Banks, during Captain Cook's first voyage, 1768–71"; this work was published in 1896.

The time-consuming and exacting labour which the preparation of the Indian flora entailed had barely ended when the chivalrous generosity of Hooker was once more invoked. The late Dr. Trimen had undertaken the preparation of a "Handbook of the Flora of Ceylon." Three volumes of this work were issued between 1893 and 1895. While it was in progress Trimen was mortally stricken; the third volume was issued with the hand of death upon the author. When Trimen died the Government of Ceylon sought Hooker's aid. With indomitable courage the veteran of over eighty undertook the heavy task of completing the work of another author who had fallen a victim in the prime of life, under restrictions as to scope and style which, whether they met with his approval or not, were at any rate different from those hitherto observed by himself. Perhaps no more touching token of regard than this was ever paid to the memory of a friend. The fourth volume of the Ceylon flora, to some extent edited from material left by Trimen, appeared in 1898; the fifth and concluding volume, which it fell to Hooker to prepare himself, was issued in 1900. Still, as he himself once expressed it, "dragging the lengthening chain" of the *Botanical Magazine*, Hooker devoted the next two years of his own life to writing that of his father, which appeared in the "Annals of Botany" in December, 1902. Coincident with the appearance of this tribute of filial piety came the arrangement which relieved him of some of the pressure which the editing of the *Magazine* entailed, but not the anticipated freedom. At the request of the Government of India, Hooker undertook to prepare for the "Imperial Gazetteer" a sketch of the vegetation of the Indian Empire. This task, one of the most difficult, when regard is had to the limitation of space almost necessarily

imposed, that could well be undertaken, was successfully accomplished, and has resulted in an essay comparable with that on the botany of Syria and Palestine, written thirty years earlier.

The active intellect which had for five and sixty years taken a fierce delight in laborious days, and had throughout found a task to be more congenial in proportion to its difficulty, was not likely to seek satisfaction in an unbroken round of quiet breathing. If new worlds need not be sought for conquest, at least some unregulated province might be reduced to order. Among the families of Indian plants dealt with by Hooker and Thomson in their "Præcursores" one of the most fascinating, whether for the variety of its forms or the intricacy of their relationships, had been the Balsamineæ. Since 1859, when their paper appeared, a host of new Indian and Chinese forms had been reported; the characters met with in some of these appeared to invalidate earlier conclusions. To the study of this interesting group Hooker devoted his attention from 1904 onwards, evolving order out of an apparent chaos, and in the course of his studies placed those in charge of most of the important herbaria in Europe under a deep obligation, by supplying them with a uniform nomenclature for their specimens. On this work, which, so far at least as the Asiatic forms are concerned, had been practically completed, Hooker was engaged almost to the last.

Shortly summarised, and omitting here any reference to excursions into the domain of economic, morphological, and physiological botany, or to systematic studies of material from countries in which he did not himself travel, we find evidence of the existence of several definite lines of active interest, athwart which fell the shadow of various outstanding events in Hooker's career. The record indicates that Hooker's strongest and earliest predilections were perhaps towards the study of cryptogamic plants and work on fossil botany. The first predilection reached its culmination in 1844, when he returned from the circumpolar expedition on which he had started in 1839. The pressure exercised by problems, to the elucidation of which the evidence of flowering plants with their more special organisation and more restricted distribution is of greater value, gradually led to the abandonment of this field of study, which was not re-entered after he left for India in 1847. The predilection for work on fossil botany naturally reached its culmination while Hooker was attached to the Geological Survey. Its influence, though not entirely inhibited, was less active after Hooker's return from the East, and this field of study was abandoned when he became assistant director of Kew in 1855.

The predilection for the study of those problems that relate to the origination and distribution of species, to which his experience as a field naturalist on circumpolar islands and among the peaks and valleys of the Himalayas had given so great an impetus, reached its culmination while he was assistant director at Kew, and is manifested most strongly in the classical essays which date from 1860 to 1866. Without attempting to estimate the interaction effects of the work of Darwin on that of Hooker and *vice versa*, we may here direct attention to the fact of their existence. Nor could it be otherwise; the two men studied and wrote, on terms of intimate and affectionate friendship, in an atmosphere surcharged with great and pregnant thought.

With Hooker's succession to the directorship of Kew in 1865, the Antarctic work had practically ended, for the concluding moiety of the New Zealand handbook appeared in 1867. He was now able to do for India what he had already done for Tasmania and New Zealand, and if, when he retired in 1885, only half of his Indian systematic work had been accomplished, there was no break in its continuity. If we except his masterly sketch of the vegetation of India, prepared after the "Indian Flora" had been completed, we are without a record of his conclusions from Indian botanical evidence, comparable with the brilliant generalisations based on his study of the Arctic, Antarctic, and insular floras of the globe. This may be a cause for regret; it can be no cause for surprise. Not only is the Indian field the wider of the two; Hooker completed the essential preliminary spadework in the other during the sixteen years between 1844 and 1860, whereas the corresponding Indian toil exacted over forty years of labour between 1854 and 1897. When the Indian preliminary work was done it only served to prove that the relationships of the Indian, Malayan, and Chinese floras are so intimate as to demand their conjoint consideration.

The completion of the "Indian Flora" in 1897, rather than the demission of the directorship at Kew, marks the close of a period in Hooker's work. The next epoch, a comparatively brief one, was devoted to the performance of acts of piety to the memory and regard for the wishes of predecessors or of contemporaries whom he had outlived. These tasks ended, the evening of his life was devoted by Hooker to work which in many respects was, even for one so wide in his range and so varied in his interests, a new departure. His great "Antarctic Flora," his still greater Indian one, are splendid examples of broad canvases upon which in bold and striking lines the hand of a master has depicted the salient and essential features of a highly diversified landscape, and no one has ever portrayed with a surer touch. In the work to which Hooker devoted the closing years of his life, he has treated a single natural family as a precious gem, upon which, with a hand as sure as the one that has given us the ample atmosphere of his great pictures, he has engraved an exquisite intaglio.

To offer here an estimate of the quality of Hooker's work would surely be out of place. That task has already been performed in the pages of NATURE by one who was in the strictest sense Hooker's contemporary, and who, if he had not the advantage of such perspective as time affords, at least had all the benefit of distance in space to aid his judgment. It is sufficient here to say that the estimate made in 1877 has been fully sustained by all that has happened since; it is, moreover, interesting to reflect that the hope then so fondly expressed that Hooker, already in his sixtieth year, might still be only in mid-career has been fulfilled almost to a day. If it be urged that in one respect the judgment of 1877 is at a disadvantage as being from the pen of one who, like Darwin, was bound to Hooker by the ties of almost lifelong affection, then we can only say that no one now alive who has enjoyed the privilege of Hooker's acquaintance may venture to judge his work, because to know Hooker was to love him. The breadth of his interests, the depth of his knowledge, and the wisdom of his counsel combined to inspire reverence and regard. But above all these qualities, and beyond the singular charm of his manner, shone the unstudied and unstinted kindness which compelled affection.

A member of the Linnean Society since 1842, Hooker was a member of the council during twenty-four years, and for fifteen of these was one of its vice-presidents. He was also a member of the Geological Society, which he joined in 1846. He was elected a fellow of the Royal Society in 1847, and served on the council during seventeen years, for six of these as a vice-president and for five as president. A correspondent of the Institute and a member of the Academies of Berlin, Bologna, Boston, Brussels, Copenhagen, Florence, Göttingen, Munich, Rome, St. Petersburg,

Stockholm, and Vienna, he enjoyed, in addition, the freedom of practically every society or corporation devoted to the promotion of natural or technical knowledge within and beyond the British Empire. Not a few of these bodies have bestowed on Hooker still further distinctions. On the recommendation of the Royal Society he received a Royal medal in 1854; by the same society he was awarded the Copley medal, its highest honour, in 1887, and the Darwin medal in 1892. From the Society of Arts he received their Albert medal in 1883; from the Geographical Society their Founder's medal in 1884; from the Linnean Society their Linnean medal in 1888, a medal struck to celebrate his own eightieth birthday in 1897, and one of the medals struck in 1908 to commemorate the fiftieth anniversary of the publication of the joint communication of Darwin and Wallace on natural selection, in the original presentation of which to the society he had played so important a part. The Manchester Philosophical Society awarded him a medal in 1898, and in 1907 he received, in circumstances of singular dignity, from the Swedish Academy, what he himself has characterised as the crowning honour of his long life—the solitary medal, struck especially for the occasion, to commemorate the two hundredth anniversary of the birth of the great Linnæus.

Among his academic distinctions were the honorary degree of D.C.L., conferred upon him by the University of Oxford, and that of LL.D. from the Universities of Cambridge, Edinburgh, Dublin, and his own *alma mater*, Glasgow.

His foreign distinctions have included membership of the Royal Swedish Order of the Polar Star and the Royal Prussian Order "Pour le Mérite." By his own Government he was made a C.B. in 1869, the year following his presidentship of the British Association; he was made a K.C.S.I. in 1877, towards the close of his presidentship of the Royal Society. He was in 1897 promoted to the grade of G.C.S.I., when, in his eightieth year, the "Flora of British India" was completed; and in 1907, on his ninetieth birthday, he received the Order of Merit.

Hale and robust in his venerable old age, the veteran Hooker not only attended the Darwin-Wallace celebration organised by the Linnean Society in 1908, addressing the delegates and fellows present in a speech which recounted the part played by himself half a century earlier; he also attended the celebration at Cambridge in 1909 which commemorated the centenary of the birth of his friend Darwin. At work until within a few weeks of his death, and keenly interested in current topics to the last, Hooker passed peacefully away in his sleep, at his residence, The Camp, near Sunningdale, at midnight on Sunday, December 10. As was befitting, an invitation was offered to receive his remains in Westminster Abbey. Hooker had, however, expressed his wish that they should rest in the tomb in which his illustrious father's body was laid. This wish was fulfilled, and on Friday, December 15, he was buried in the family grave in the old churchyard of Kew. The *cortège* followed the coffin to the church, as was meet, from the house so long occupied by, and so full of memories connected with, his father and himself. At Kew, where so much of what he accomplished was done, he sleeps with his people, and Kew with its old churchyard is now more sacred even than it was to botanical pilgrims.

Among the mourners were the following members of the family, representatives of scientific societies and other institutions, and fellows of the Royal and the Linnean Societies:—

Lady Hooker (widow), Miss Grace Hooker (daughter), Mr. William Hooker, Dr. and Mrs. Charles Hooker, Mr. R. H. Hooker, Mr. R. S. Hooker, Sir W. T. Thiselton-Dyer, Miss Thiselton-Dyer, Mr. G. H. Thiselton-Dyer, Miss Symonds, Mr. R. Symonds, Mrs. Calverley-Bewicke, Mr. R. Woodward, Mr. R. Woodward, jun., Rev. G. Barker, Mr. G. Barker, Mrs. Crowder, Captain A. L. Henslow, Mr. Malleson, Mr. Murray, Miss Palgrave, Mrs. Paul Waterhouse, Miss M. Smith, Sir Arthur and Lady Rücker, the Hon. Mrs. H. Darwin, Mrs. Prain, Miss Younghusband, Mr. A. H. Lyell, Captain F. H. Lyell, Dr. Trail, Rev. A. G. Musgrave; the servants from The Camp, Sunningdale. Royal Society: Sir A. Geikie (president), Sir J. Larmor and Sir J. R. Bradford (secretaries), Lieut.-Colonel A. W. Alcock (council), and Prof. Bayley Balfour, Regius Keeper of the Botanic Garden, Edinburgh. Society of Antiquaries: Dr. C. H. Read (president). Linnean Society: Dr. D. H. Scott (president), Dr. B. D. Jackson and Dr. O. Stapf (secretaries). Geological Society: Prof. W. W. Watts (president), Prof. J. W. Judd (past-president). Royal Geographical Society: Mr. W. E. Darwin, Lieut.-Colonel H. H. Godwin-Austen. British Science Guild: Sir Norman and Lady Lockyer. Entomological Society: Prof. Meldola. British Medical Association: Mr. G. A. Peake. Royal Horticultural Society: Sir D. Morris, Mr. J. H. Veitch. Pharmaceutical Society: Mr. E. M. Holmes. University of Glasgow: Prof. F. O. Bower. Natural History Museum: Mr. E. G. Baker. West Indies: Mr. W. Fawcett. Royal Botanic Gardens, Kew: The Director, with the whole of the permanent staff, and with detachments representing the constabulary and the labour departments. Sir G. Darwin, Dr. F. Darwin, Sir A. Church, Prof. S. H. Vines, Mr. G. C. Druce, Prof. D. Oliver, Prof. F. W. Oliver, Mr. A. Henry, Dr. A. Günther, Prof. G. S. Boulger, Mr. J. S. Gamble, Mr. W. B. Hemsley, Mr. J. Britten, Mr. J. R. Drummond, and Dr. F. N. Williams.

NOTES.

We are pleased to be able to report that Dr. R. T. Glazebrook, the director of the National Physical Laboratory, who has for some time been seriously ill with enteric fever, has recently been making good progress towards recovery. A marked improvement has been shown during the last few days, and it is hoped that he may shortly be regarded as convalescent.

The Rt. Hon. the Earl of Cromer, G.C.B., and the Hon. Lionel Walter Rothschild, have been elected fellows of the Royal Society under the statute which empowers the council once in every two years to recommend to the society for election not more than two persons who in their opinion have rendered conspicuous service to the cause of science. The following have been elected foreign members of the Royal Society:—Dr. Johann Oscar Backlund, of Pulkowa, Imperial Astronomer of Russia; Dr. Heinrich Ritter von Groth, professor of mineralogy in the University of Munich; Heinrich Kayser, professor of physics in the University of Bonn; M. Joseph Achille Le Bel, of Paris, the distinguished chemist; and Klement A. Timiriazeff, professor of botany in the University of Moscow.

At a meeting of the executive committee of the British Science Guild, held on December 13, it was decided that the lecture scheme recently proposed should be commenced at the end of January. Sir Edward Brabrook agreed to read the first paper, on the scientific aspects of charitable effort. Prof. Perry will give a paper on problems in technical education in connection with national industries, and Mr. Frederick Verney on agricultural problems. After the reading of papers the meetings will be open for discussion. The meetings will be held in the rooms of the Chemical Society at dates to be announced later.

The conditions just issued by the War Office for the Military Aëroplane Competition have met with general

approval, and as they are frankly based on the recent French competition rules, and call in some instances for more difficult tests, it is felt that the winning machines will represent the best productions at present obtainable. The prizes are divided into two classes: (*a*) For aëroplanes made in any country (open to the world), first prize, 4000*l.*; second prize, 2000*l.* (*b*) For aëroplanes manufactured wholly in Great Britain, except the engines (open to British subjects), first prize, 1500*l.*; two second prizes, 1000*l.* each; three third prizes, 500*l.* each. There are, in addition, consolation awards of 100*l.* each for ten machines which undergo all tests and do not receive a prize, and the War Office is to have the option of buying any of the prize machines at 1000*l.* apiece. The chief conditions to be fulfilled are as follows:—The machine, which must be a two-seater fitted with dual controls, must rise without damage from long grass, clover, or harrowed land in 100 yards in a calm, carrying a live load of 350 lb. in addition to instruments and oil and fuel for 4½ hours' running. In rising, the height of 1000 feet must be reached in five minutes, and it must fly for three hours continuously, of which time one hour must be passed at an altitude of 4500 feet. Before landing, a glide of not more than 1000 feet will be required, and the angle must be not less than 1 in 6. The landing must be made without damage on any cultivated ground, including rough plough. Among the desirable attributes of the aëroplane are mentioned a silencer to the engine, flexibility of speed, and an engine capable of being started from on board.

IT is with much regret that we see the announcement of the sudden death of Prof. Andrew G. Ashcroft, of the City and Guilds (Engineering) College, South Kensington, S.W., at fifty-two years of age. Prof. Ashcroft was a student at University College, London, and at the conclusion of his student career he was attached to the staff of the Engineering School. For some time he was engaged in constructional engineering work at the Alexandra Palace, and in other practical work of a similar nature. He returned to the Engineering School of University College, London, to act as assistant to Prof. T. H. Beare and Prof. (now Sir) Alexander Kennedy. Whilst acting in this capacity he lectured on engineering subjects at the East London College, then the People's Palace. At this period of his career, coincident with the recognition of the importance of technical education, he was appointed head of the Woolwich Polytechnic, and his work in this position showed that he was a shrewd and capable organiser. He left Woolwich to take up the work of assistant professor of civil and mechanical engineering at the Central Technical College, London. Prof. Ashcroft was keenly interested in the subject of the strength of materials, and was an expert in the measurement of small strains. Amongst other instruments, he designed an extensometer for measuring elastic strains; a delicate cross-strain measurer for the determination of Poisson's ratio; and a hand-testing machine for small tension pieces with a specially delicate autographic recorder. His written contributions to various societies include papers on properties of malleable iron, instruments of precision, and the measurement of air supply to internal-combustion engines. Prof. Ashcroft was a member of many societies, and took an active interest in the welfare of each one of the numerous social clubs which exist at the college where he worked. He was universally popular with the students, and the engineering profession is the poorer for the loss of so attractive a personality.

A SERIOUS explosion, resulting in injury to eighteen officers and men, occurred on December 12 during certain trials which were being carried out on board H.M.S. *Orion* at Portsmouth. From the newspaper accounts it appears that official tests of one of the dynamos were in progress when the explosion took place. The explanations put forward attribute the accident to the ignition of inflammable vapour given off from the oil used as a lubricant of the dynamo. One suggestion is that the production of vapour was due to overheating of the bearings: this would imply either that the lubricant was unsuitable or that it was not properly applied. Whether in this particular case the explanation is the true one or not, it seems at least probable. Lubricating oils are generally composed of high-density petroleum products, used either alone or mixed with a proportion of vegetable or animal oil. Numerous varieties are made to suit different types of machinery. For each type, of course, it is important to choose the appropriate lubricant. As regards inflammability, it is well known that petrol and ordinary petroleum oil for burning give off vapour at relatively low temperatures, but it is probably not so well recognised that at higher temperatures some lubricating oils may do the same. In fact, a determination of the flashing point, or at least a proof that the oil does not "flash" below a given temperature, is usually required in deciding upon the suitability of certain kinds of mineral oil for use as lubricants.

THE annual Christmas course of juvenile lectures at the Royal Institution will begin on Thursday next, December 28, at three o'clock, when Dr. P. Chalmers Mitchell will deliver the first of six lectures on "The Childhood of Animals."

AT the recent annual meeting of the Yorkshire Numismatic Fellowship, held at Leeds, Mr. T. Sheppard, of the Municipal Museum, Hull, was elected the president for the year 1912, and editor of the society's Proceedings.

A JOINT meeting of the Institution of Mining and Metallurgy and the Canadian Mining Institute will be held at Toronto on March 6, 1912, and the following days. The meetings for the reading and discussion of papers will occupy three days, March 6, 7, and 8. The annual dinner of the Canadian Institute will be held on March 8, and on March 9 an excursion to the mining districts of Cobalt and Porcupine will be arranged, provided a sufficient number of the members of the English institution wish to visit those localities. Further details of the arrangements may be obtained from the secretary of the institution, Mr. C. McDermid, at Salisbury House, London, E.C.

IN proposing the toast of "The Institution of Mining and Metallurgy" at the annual dinner of the institution, held on December 15 at the Savoy Hotel, Sir Alfred Keogh announced that the Bessemer Memorial Committee will, in January, hand over to the Royal School of Mines the laboratory which it has presented to the Imperial College of Science and Technology. Mr. Sulman, in responding to the toast, said that the world's production of gold in the form of standard metal since 1880 has exceeded 1,000,000,000*l.* sterling, more than one-half of which has been won from mines within the British Dominions. The British capital involved in metalliferous mining, apart from coal and iron, during the past twenty-five years exceeds 900,000,000*l.* sterling. During the past four years there has been subscribed as working capital for metalliferous mining, outside coal and iron, above 4,500,000*l.* sterling.

IT is well known that the late Mr. J. R. Mortimer, the Driffield antiquary, was an authority on the prehistoric and other earthworks of East Yorkshire, and during the past half-century he made a careful survey of all that

remains relating to the military and domestic life of the early people who built them, a subject upon which he wrote many papers. Several of the structures which were known to Mr. Mortimer forty or fifty years ago, or less, have since entirely disappeared, as a result of agricultural and other operations. Fortunately, Mr. Mortimer carefully recorded his observations upon a large series of Ordnance maps of the district, and also particulars of the barrows, the Roman remains, the pits from which he obtained his geological specimens (most of which are now closed), &c. This valuable collection of maps has been presented by Major Mortimer to the Municipal Museum at Hull, where it can be referred to by students and others interested. In addition are large numbers of sketches, plans, photographs, negatives, &c., bearing upon East Yorkshire antiquities.

THE second annual general meeting of the Society of Engineers (Incorporated) was held on December 11, Mr. John Kennedy, vice-president, being in the chair. The following were elected as the council and officers for 1912:—*President*, J. Kennedy; *vice-presidents*, A. Valon, H. C. H. Shenton, N. Scorgie; *members of council*, H. Adams, C. T. Walrond, P. Griffith, T. E. Bower, H. C. Adams, J. R. Bell, S. Cowper-Coles, H. P. Maybury, B. H. M. Hewett, F. H. Hummel; *associate member of council*, E. Scott-Snell; *hon. secretary and treasurer*, D. B. Butler. It was announced that premiums for papers read at meetings and published in the Journal during 1911 had been awarded as follows:—the president's gold medal to Mr. W. R. Baldwin-Wiseman, for his paper on the administrative aspect of water conservancy; the Bessemer premium of books or instruments, to the value of 5*l*. 5*s*., to Mr. R. W. A. Brewer, for his paper on two-stroke cycle engines; the Clarke premium, value 5*l*. 5*s*., to Mr. T. J. Gueritte, for his paper on the mechanical installation and upkeep of permanent way on railways; a society's premium, value 3*l*. 3*s*., to Mr. E. Kilburn Scott, for his paper on nitrogen products made with the aid of electric power; a society's premium, value 3*l*. 3*s*., to Mr. Frank G. Woollard, for his paper entitled "Some Notes on Drawing-office Organisation."

THE annual general meeting of the Scottish Meteorological Society was held on December 12. From the report of the council, which was adopted at the meeting, we learn that during the past twelve months several additions have been made to the society's system of stations. A fully equipped station has been established by Mr. G. Craig Sellar at Ardtornish, on the Sound of Mull, and represents effectively an interesting region from which observations were greatly needed. New stations have also been established at Aviemore by the Aviemore Station Hotel Company, and at Carrbridge by the Rev. Andrew Doak, and these will add to the scanty knowledge of the meteorology of the Central Highlands. The council points out once more that there is urgent need for additional information regarding the rainfall of the Highland area and the north of Scotland. Apart from the purely scientific value of rainfall records, the rainfall of a district touches practical and sporting interests at many points, and it seems to the council that it may reasonably look to large landowners and shooting tenants for help. It may be pointed out that the final report of the recent committee of inquiry on grouse disease has something to say on the importance of meteorological conditions in relation to the distribution and the health of grouse. It appears that where rainfall is very heavy there is little disease, but grouse are few, the scarcity of the birds being due probably to the deleterious effect on heather of a high rainfall. The council elected for the ensuing twelve months is as follows:—*President*, Prof. A. Crum Brown, F.R.S.; *vice-presidents*, Ralph Richardson, W.S., Dr. C. G. Knott; *council*, Sir David Paulin, Gilbert Thomson, H. M. Cadell, Sir A. Buchan-Hepburn, Bart., G. G. Chisholm, M. M'Callum Fairgrieve, J. Mackay Bernard, Dr. J. R. Milne, T. S. Muir; *hon. secretaries*, R. T. Omond, E. M. Wedderburn, W.S.; *hon. treasurer*, W. B. Wilson, W.S.

IN a report presented to the French Institute of Anthropology, published in *Comptes rendus* for March-June, M. Boule discusses the morphology of the mammoth as displayed in recent discoveries of Palæolithic art. He points out that certain physical peculiarities of the animal, which were only recently established by the discovery of a specimen by M. Wollosowitch at Sanga-Iurach in 1908, already appear in stone carvings dating from the Palæolithic age.

IN vol. xxii., Nos. 4–5, of *L'Anthropologie*, Dr. Lalanne and L'Abbé H. Breuil describe a series of remarkable Palæolithic sculptures on a cliff at Cap-Blanc, Laussel, Dordogne. Among the animals represented are a bison and a pair of horses, depicted in the usual vigorous style of the art of that period. This discovery supplies a welcome addition to the cave sculptures of a similar class already familiar to archæologists. It is now proved that these early artists, in addition to work carried out by torchlight in dark, damp caves, executed similar sculptures in the open air.

THE work of the modern school of French anthropology is largely devoted to the preparation of elaborate memoirs in which the results of the investigation of specially interesting races are summed up and criticised, with a complete apparatus of facts and statistics. Such is the admirable account contributed to vol. xxii., Nos. 4–5, of *L'Anthropologie* by Dr. Poutrin, entitled "Les Négrilles du Centre Africain (type sous-dolichocéphale)," in which he has collected all the information at present available on the Pygmy races. The introduction, illustrated by a map, shows the distribution of these people, and is followed by a historical account of exploration and an elaborate survey of the physical characteristics. Probably no account of this remarkable race, already available to students, contains a more complete survey of the ethnological problems connected with the Pygmies of Africa.

ACCORDING to the fourth annual report (1910–11) of the National Museum of Wales, the designs for the new building have been considerably modified, with, it is believed, a great improvement in the general appearance of the structure. Illustrations are given of the exterior and of the entrance hall, together with plans of the ground-floor and the two floors above. A contract has been signed for the construction of the basement and sub-basement for that portion of the building proposed to be erected in the first instance, which includes the south block and the lecture theatre and gallery above, and work on this was commenced in September last. Considerable progress has been made in collecting specimens for exhibition and study.

WE have received a copy of a petition from the natives of India presented to H.M. the King at the Delhi Durbar (together with a covering appeal signed by K. S. Jassawalla, of 45 Courthope Road, Hampstead), praying that the supply of beef required for the British Army in India may in future be obtained from Australia in place of India itself. The petition is accompanied by a large illustration showing the various uses to which Indian cattle are put. So great is the demand in the country for cattle for purposes of draught and agriculture that, according to the petition, cows are chiefly slaughtered for beef. This practice is one of the causes which have led to a great diminu-

tion in the number of cattle in the country, with a corresponding rise in the price of milk and ghi (native butter). It is further urged that the quality of Indian beef is far inferior to that of Australian beef, and likewise that the use of the latter in the Army commissariat would not entail any very great additional cost.

MR. A. H. THAYER's suggestive observations upon protective coloration in nature have been described in these columns on more than one occasion, and his son's beautifully illustrated work upon it was reviewed in detail a little more than a year ago (October 27, 1910). A number of illustrations from that work are reproduced in colour in the December number of *Pearson's Magazine*, and the principle they exemplify is described in an instructive article by Mr. Marcus Woodward. Mr. Thayer's view is that it is the rule for animals to be coloured like the background which most concerns their feeding and escape from attack. There are limitations to the application of this interpretation of obliterative colouring throughout the animal kingdom; but there is no question as to the great importance of the principle of countershading in nature, and the article and pictures in *Pearson's Magazine* should be the means of interesting many people in it.

THE latest issue of *The Kew Bulletin* (No. 9) is mainly occupied by systematic articles. The most interesting is a description of six new species of Impatiens from Travancore and Cochin, contributed by the late Sir Joseph Hooker. The list of additions to the wild fauna and flora of the gardens is due in great measure to the collection of specimens by members of the garden staff. Noteworthy is the announcement of a heath from Cornwall which appears to be a natural hybrid between *Erica tetralix* and *E. vagans*.

THE annual Kew list of seeds of hardy herbaceous plants and of trees and shrubs available for exchange with botanic gardens and regular correspondents has been published as Appendix I. to *The Kew Bulletin* (1912). The list reflects in some measure the outcome of the remarkably fine summer, notably in the ripening of the seeds of trees and shrubs; thus there are offered for exchange the seeds of *Clerodendron dichotomum*, which has fruited at Kew for the first time on record, *Koelreuteria paniculata*, *Buddleia globosa*, and two species of Halesia.

BOTANICAL exploration in India is summarised by Major Gage, as director of the botanical survey, in his report for the year 1910–11. An expedition to the south-east corner of Sikkim was undertaken by Mr. W. W. Smith. Captain R. W. Macgregor presented an interesting collection of specimens from the Southern Shan States, and a smaller collection was forwarded by Mr. Burns from Bombay. In the south, the most important contribution was made by Mr. A. Meebold, as the result of an extensive tour through the States of Cochin and Travancore. A second fasciculus of the catalogue of non-herbaceous phanerogams cultivated in the Calcutta Botanical Gardens has been published as vol. v., No. 2, of the Records of the Botanical Survey of India.

ON Monday, December 18, Dr. D. T. Macdougal, director of the department of botanical research of the Carnegie Institution of Washington, lectured before the Royal Geographical Society on the North American deserts. After describing the general characters of desert areas, and explaining the importance of the various factors involved, he passed on to give a short account of the study of such regions which is being carried on by the Carnegie Institution. A large series of lantern-slides, many of them in colour, showed very instructively the character of the desert regions of Arizona and California, and of the types of vegetation which are able to flourish there both under normal conditions and also by the aid of artificial constructions, such as the concrete walls which are sunk in the detritus-filling valley floors in order to hold up to a higher level the water, which otherwise flows at a depth which is out of the reach of surface vegetation. The formation of the Salton Lake was also described, and its effect on the vegetation of the basin was illustrated. Dr. Macdougal is leaving shortly to visit the deserts of Egypt and the northern Sudan.

IN the Monthly Meteorological Chart of the Indian Ocean for December, issued by authority of the Meteorological Committee, a considerable space (as in previous months) is devoted to a useful discussion of ice reports, relating to the southern hemisphere, which subject has for many years occupied the serious attention of the office. In the Southern Ocean icebergs are most frequently met with to the north-east of Cape Horn, south-east of the Cape of Good Hope, midway between Kerguelen and the meridian of Cape Leeuwin, and midway between New Zealand and Cape Horn. Tables of the monthly and annual frequency of the bergs from 1885 to 1910 show that the periods of maxima and minima vary irregularly; the years of greatest frequency were 1893 and 1906. In the chart for the North Atlantic the ice conditions are also discussed. A sub-chart of the exceptional drifts and heights of bergs shows that the latter were most frequent in the ten-degree square of lat. 40°–50° N. and long. 40°–50° W., but some few were observed nearly so far south as lat. 30° N. The first ice seen in 1911 was on January 28, near lat. 47° N. and long. 52° W.

IN an interesting paper recently published in the *Bollettino* of the Italian Seismological Society (vol. xv., 1911, pp. 144–53), Prof. G. Grablovitz has traced the variations in the mean level of the sea at Ischia during more than twenty years. From 1890 to 1894 the mean level furnished by the mareograph records remained not far from constant, but from 1895 onwards there has been a marked change, after the effects of barometric variation have been allowed for. The change is not always in one direction; but during the sixteen years from 1895 to 1910 there has been, on the whole, a rise in the sea-level, the average annual amount being 3 or 4 millimetres a year. The mareograph records at Genoa also indicate a gradual, though much less pronounced, rise in the apparent level of the sea.

IN his well-known investigations on the after-shocks of earthquakes Prof. Omori finds that the law of decline in frequency is of the form $y=k/(x+h)$, where y is the daily number of after-shocks at time x after the parent earthquake, and h and k are constants which vary with every earthquake. Mr. A. Cavasino has recently examined the validity of this formula in regard to the after-shocks of the Riviera earthquake of 1887, one of the first earthquakes in which the after-shocks were studied in detail (*Boll. della Soc. Sismol. Ital.*, vol. xv., 1911, pp. 129–43). Determining the values of the constants from the recorded numbers of sensible shocks during the first five days, he shows that the agreement between the numbers furnished by the formula and of those actually observed is at first fairly close, but that, after the lapse of a few years, the formula fails to give correct results. The discrepancy may be due partly, as he suggests, to the difficulty of determining the average seismicity of the district. It may also be due to the small number of records used in determining the constants of the equation.

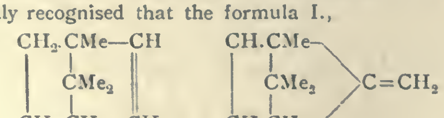
IN the *Atti dei Lincei*, xx. (2), 6, Prof. A. Garbasso describes a repetition, with modern apparatus, of the classical experiment of Volta and Bennet, according to which the flame of a candle discharges the conductor of an electroscope. In this case a Ramsden's electric machine and an Exner electroscope were used at a distance of 15 metres apart, and it was observed that on working the machine the electroscope readings increased; on stopping it they decreased, then rose to a maximum, and then again fell.

SIR GEORGE GREENHILL, writing in *The American Journal for Mathematics*, xxxiii., 4, develops the result obtained by G. W. Hill, according to which the potential of a homogeneous spherical segment (*e.g.* a flat lens) at any point can be made to depend on elliptic integrals. This result depends on the method of dissection employed; in this case the segment must be supposed cut into slices perpendicular to the line joining the centre to the point at which the potential is required.

ACCORDING to a paper by Messrs. Kinoshita and Ichinohe in vol. iii. of the Memoirs of the Science and Engineering College of the University of Kyoto, the ionisation current from a metal filament when heated above 2400° absolute ceases to be represented by Prof. Richardson's equation $C=A\sqrt{\theta}.e^{-b/\theta}$, where C is the value of the saturation current, θ the absolute temperature, and A and b constants depending on the nature of the metal. They put this down to the fact that the equation is deduced on the assumption that the whole of the saturation current is carried by the ions emitted by the heated filament. At the high temperatures they attained they consider the kinetic energy of the moving electrons sufficient to enable them to ionise the gas molecules with which they come into contact. The magnitude of the current thus produced appears to be roughly half that of the total current observed.

THE *Verhandlungen der Deutschen Physikalischen Gesellschaft* for November 15 contains a short report laid before the meeting of the Naturforscher und Aerzte at Karlsruhe by Drs. Scheel and Heuse, on the measurements of the specific heat of air at ordinary and at very low temperatures recently made at the Reichsanstalt. The method used was that of "continuous flow," the air passing through a vacuum-protected tube in which it was heated by a wire carrying an electric current, its temperature on entering and in leaving being measured by platinum thermometers. The results for the specific heat are as follows:—at 20° C., 0·241; at −78° C., 0·243; at −183° C., 0·252. There is, therefore, a distinct increase of the specific heat as the temperature decreases. The result at 20° C. agrees to within 1 part in 1000 with that obtained by the same method by Dr. Swann, and published in the Proceedings of the Royal Society of London in 1909. The complete account of the work of Drs. Scheel and Heuse is to appear in the *Annalen der Physik*.

THE November issue of the Chemical Society's Journal contains a paper by Prof. G. G. Henderson and Mr. I. M. Heilbron on the constitution of camphene. It is now generally recognised that the formula I.,



I. Bornylene. II. Camphene.

originally proposed by Bredt, is in reality that of the closely related bornylene, as is shown by its preparation from borneol through the xanthate, and by the ease with which it is converted into camphoric acid by oxidation. A great many of the reactions of camphene indicate the presence of the methylene group $>C=CH_2$ in this compound, and on the basis of much experimental evidence the authors consider the formula II., originally proposed by Semmler, to be the best expression of the known facts.

AN interesting case of isomerism is discussed by Messrs. Laws and Sidgwick in the November number of the Chemical Society's Journal. The phenylhydrazone of acetaldehyde possesses the remarkable property that the α-form, melting at 98°, and the β-form, melting at 56°, can be converted almost quantitatively one into the other by the action of a mere trace of acid or alkali; thus crystallisation from aqueous alcohol containing a trace of potassium hydroxide gave the high-melting α-form, whilst recrystallisation from aqueous alcohol containing a trace of sulphur dioxide gave the low-melting β-form. This peculiarity of the isomerism is obviously connected with a very small difference in the energy-content (and therefore in the stability) of the two forms. This factor is usually overbalanced by a marked difference in the solubility of the two forms, a difference which sometimes favours either the one or the other form according to the solvent from which the material is crystallised. But in the case under consideration the difference of solubility almost disappears on account of the fact that the two forms are isomorphous. Their interconversion can therefore take place with peculiar facility, and in the case of the solids may be brought about by gaseous acids and alkalis without producing any alteration in the appearance of the crystals.

Engineering for December 15 contains an account of some valuable experiments on the strength of thick hollow cylinders under internal pressure, carried out by Messrs. Gilbert Cook and Andrew Robertson at the University of Manchester. The object of the experiments was to test the various theories for the manner of failure, and cylinders both of cast iron and of mild steel were tested. In the case of cast iron, elastic limit and rupture are practically coincident; the results of the experiments show that the failure is determined solely by the maximum principal stress, and Lamé's formula,

$$p=f\frac{k^2-1}{k^2+1},$$

may be used directly. In this formula f is the stress at failure in simple tension, and k is the initial ratio of the diameters. In the mild-steel cylinders tested, initial yield took place when the pressure was about 20 per cent. in excess of that required by the shear-stress theory (Guest's law); the pressure may be calculated very nearly by the equation

$$p=0{\cdot}6f\frac{k^2-1}{k^2}.$$

Tests were also made on the ultimate strength of mild-steel cylinders. The results may be denoted empirically by the same formula that applies to cast iron.

WE have received from Messrs. James Woolley, Sons and Co., Ltd., of Victoria Bridge, Manchester, a copy of their "Scientists' Reference Book and Diary for 1912." In addition to a conveniently arranged diary, in which each week of the year is given a page, a reference book containing useful information as to important facts and constants continually required by workers in science is provided. The tables and other data have been carefully revised, and will prove of great service. The price of the publication is 1*s*. 6*d*.

THE report of the Clifton College Scientific Society for the year 1910–11 has been received. This year, for the first time, the report is illustrated. The numerous sections of the society were very active during the period under review, but the attendance at general meetings does not appear to have been so good as in previous sessions. The report shows that many of the masters join with the boys in their practical study, in leisure hours, of various branches of science. Great prominence is given to outdoor work of a kind likely to engender a love for scientific observation and research among the boys.

THE issue of "Hazell's Annual" for 1912 maintains the high character for usefulness which previous editions of this work of reference have gained. The contents have been revised to November 25 last, and the editor, Mr. Hammond Hall, claims that the compilation gives "the most recent and authoritative information on the topics of the day." One section of the volume, running to forty-two pages, is entitled "The March of Science," and deals, among other subjects, with scientific progress in 1911, imperial research, and aërial navigation. This is the twenty-seventh year of issue of the annual. The price of the volume is 3*s*. 6*d*. net.

COPIES of the 1912 issues of the well-known works of reference published annually by Messrs. A. and C. Black have been received. "Who's Who" is larger than ever; the 1911 edition ran to 2246 pages, but the new volume contains 2364 pages. There is a remarkable variation in the lengths of the autobiographies contained in this indispensable volume; some consist of two or three lines only, while others take up nearly a page. It is satisfactory to find, in view of the important part which science takes in modern States, that due prominence is given to men of science in this record of living notabilities. "Who's Who Year-book" contains, as usual, the well-arranged tables which were formerly a popular feature in "Who's Who" itself. "The Englishwoman's Year-book and Directory" should be in the hands of every woman who is engaged in public work; it is crammed with useful information of a trustworthy kind. "The Writers' and Artists' Year-book" is, its editor says, chiefly for the use of those persons who wish to make money by their pen or brush.

OUR ASTRONOMICAL COLUMN.

MARS.—In a telegram, dated November 29, from Sétif, to the *Astronomische Nachrichten*, M. Jarry-Desloges states that Mare Sirenum is persistently seen cut into three parts, and that Elison is easily perceptible. Later, on December 4, he reports that Juventæ Fons is now an easy object, L. Phœnicis is triple, Bathys is apparently effaced, the Aonius Sinus encroaches on Thaumasia, and the south polar spot, in 95°, is 0·7″ in diameter.

The December number of *L'Astronomie* contains several drawings of the planet by M. Quénisset and others, with descriptions of the different features observed during October and November. The outstanding feature on October 17 was Tartarus, which, leaving the M. Sirenum at its eastern point, traversed nearly the complete disc and joined up with Trivium Charontis.

On photographs taken on one plate by Prof. Lowell on October 11, M. Flammarion has recognised fifteen different Martian features in the L. Solis region, including several canals.

BORRELLY'S COMET, 1911*e*.—Dr. Ristenpart communicates the position of comet 1911*e*, as observed at Santiago on November 26, to No. 4541 of the *Astronomische Nachrichten*, and adds that the comet was round, was less than 1′ in diameter, had a nucleus and a tail, the latter less than 30′ long, and that its magnitude was 9·0; the corrections to the ephemeris at 10h. 57·6m. (Santiago M.T.) on November 26 were +0·3′ and +0·2′.

SPIRAL STRUCTURE IN NEBULÆ.—In an interesting article published in No. 3, vol. xxxiv., of the *Astrophysical Journal*, Mr. William Sutherland discusses the relation between the distribution of the planets and the probability of their origin in a spiral nebula. He shows that the equation expressing Bode's law may be developed to show that the planetary distances are derived from two equi-angular spirals, thus leading to the idea that the solar system in its evolution passed through the spiral form so common among nebulæ, the spiral being of a simple logarithmic form. He pictures the elementary nebula as made up of meteorites rotating about a centre, the meteorites being uniformly distributed. Collisions occur, reducing the rotational velocity of the colliding bodies, and the latter fall towards the centre; but they will fall spirally, owing to the common rotation of the mass, and thus spirals of condensation would be formed. Mr. Sutherland shows how these might finally agglomerate into two-armed spirals, in which local condensations might account for the considerable variation of mass among the planets; according to this scheme, the moon and other satellites were formed from subsidiary branches to the spiral arms. Comparisons between the calculated spirality of several nebulæ and that calculated for the solar nebula from the law of distribution of the planets shows the values to be of the same order, and thus lends support to Mr. Sutherland's theory.

PERMANENT DESIGNATIONS FOR RECENTLY DISCOVERED VARIABLE STARS.—In No. 4540 of the *Astronomische Nachrichten* the commission for the A.G. catalogue for variable stars publishes the permanent names allotted to variable stars discovered recently. From the notes it is seen that most of the discoveries were photographic, and that many of them were made at Harvard. A glance at the tabulated maxima and minima suggests that the field of discovery for variable-star observers is not yet closed, for we find ranges of three or four magnitudes, *e.g.* 9·5 to 12·8, among the fainter objects.

LUMINOSITIES AND RADII OF VARIOUS STARS.—Answering a question as to the relative sizes of the stars, Mr. J. B. Cannon, of the Dominion Observatory, gives some interesting figures in No. 5, vol. v., of the Journal of the Royal Astronomical Society of Canada; he also outlines the method whereby the figures were derived.

As the surface intensities of the various spectral types, taking that of the sun as unity, he adopts 12 for types A and B, 3 for type F, 1 for type G, and 0·5 for types K and M, and derives the luminosities and radii of eighteen well-known stars. Rigel, with a radius 41·5, has a luminosity 20,614 times that of the sun. Only two stars, α Aquilæ and β Leonis, are calculated to be the same size as the sun, and are just over twelve times as luminous. The radius of the Pole Star is 5·9, and its luminosity 102, while Regulus, with six times the radius of the sun, is 423 times as luminous.

THE PHYSICAL SOCIETY'S EXHIBITION.

THE seventh annual exhibition of physical apparatus under the auspices of the Physical Society of London was held on Tuesday afternoon and evening, December 19, at the Imperial College of Science and Technology. The very large attendances at both sessions was evidence that the exhibition continues to serve a very useful purpose in bringing a knowledge of new apparatus to teachers and others interested in scientific work.

A discourse was given by the Hon. R. J. Strutt, F.R.S., at each session on electric discharge and the luminosity that survives it, in which the lecturer displayed some interesting and very pretty experiments on the afterglow which succeeds the passage of an electric discharge through nitrogen. A current of pure nitrogen was maintained through the discharge tube and passed into a large globe, in which it still maintained a yellow glow. The interaction of nitrogen in this state with nitric oxide and stannic chloride vapours was shown by the change in the colour of the glow to green and blue respectively when the vapours

were mingled with the nitrogen in the globe. Further experiments on the effect of pressure were made, and the causes of the phenomena briefly discussed.

Thirty-three firms exhibited their latest forms of physical apparatus. Only a few of the various new forms of instruments can be mentioned. A new galvanometer of the moving-magnet type was shown by the Cambridge Scientific Instrument Co., who claim for it a sensitiveness forty times that of their Broca type. The magnet system consists of two groups of very small magnets arranged on a fine glass stem, which is suspended from a quartz fibre. The coils are arranged in pairs similar to a Thomson galvanometer, and are designed to secure the maximum effect for a given resistance of copper by winding with different sizes of wire, beginning with the smallest size, and winding each layer so that it lies within the surface of which the polar equation is $r^2=d^2 \sin\theta$, where r is the length of radius, making an angle θ with the axis of the coil. The company displayed several other exhibits of their instruments for advanced work, including a Duddell oscillograph outfit for a 50,000-volt circuit. A new design of extensometer was shown by W. G. Pye and Co., for use in conjunction with a testing machine on bars and thick specimens. It was composed of the Ewing extensometer with the microscope replaced by an optical lever, and was designed to measure extensions of 1/100,000 of an inch. Several new designs of students' apparatus and a Kohlrausch bridge of new form were included among their other exhibits. A new vibragraph was shown by Siemens Brothers and Co., Ltd., consisting of a mercury reservoir with a floating mirror, by means of which a beam of light from a small glow-lamp is reflected on to a ground glass screen or photographic plate. The mercury ripples set up by the vibration of the body on which the reservoir is placed give an angular movement to the mirror, which thus produces on the plate or screen a clearly defined diagram of the vibration. The same company also showed a demonstration wireless-telegraphy set on the singing-spark system, and a number of frequency indicators.

New projection apparatus and a new level for very accurate surveying was shown by Carl Zeiss, Ltd. Photomicrographic apparatus, and an ultra-condenser for rendering an ordinary microscope suitable for ultra-microscopic observations were among the exhibits of Messrs. E. Leitz. Their latest pattern of high-vacuum oil pump was shown by A. C. Cossor, Ltd. The piston of the high-vacuum cylinder is actuated from outside by an electro-magnet, which is caused to move up and down, thus avoiding the use of a piston rod and possible leak at the stuffing boxes. The Foster Instrument Co. exhibited a simple strain-meter for observation of strains in any part of a structure, such as a girder of a bridge or frame of a ship.

Various types of switchboard instruments were shown by Nalder Bros., R. W. Paul, and the Weston Instrument Co. Among the exhibits of the last-named was a new line of alternating-current dynamometers, including wattmeters, frequency meters, and synchroscopes. R. W. Paul also exhibited a new and inexpensive form of potentiometer, various inductionless resistances, and a number of thermocouple pyrometers and temperature indicators. Messrs. Gambrell Bros. exhibited a new potentiometer for thermoelectric work, and instruments of various kinds for students' use. The Silica Syndicate displayed some wonderful examples of their wares. Electric furnaces were shown by J. J. Griffin and Sons, Ltd., together with quartz glass mercury thermometers for temperatures up to 750° C.

Demonstrations of Dr. Leonard Hill's colour vision apparatus were made at the stand of Messrs. Newton and Co. The degree of sensitivity of the eye for colours is ascertained by means of two identical spectra projected by an optical lantern from one and the same prism, and provided with separate adjustable screens for matching. Electrical apparatus for medical purposes was shown by the Sanitas Electrical Co., and X-ray apparatus by H. W. Cox and Co. E. Raymond-Barker's two-tone transmitter, exhibited by the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., and F. Harrison Glew's radio-active preparations, are two of many other interesting exhibits, of which our space does not permit us to give more detailed account.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.[1]

FOR the first time in its history the Astronomical and Astrophysical Society of America this year held its annual meeting outside the United States, and it speaks well for the progress of the comparatively young Dominion Observatory that the *locale* was Ottawa. This feeling was made the subject of a special resolution, in which a very favourable opinion as to the character of the work done in every department was united with a recommendation that a more powerful telescope may soon be provided for use in the important radial-velocity work now being executed at this observatory.

Prof. E. C. Pickering was elected president, Profs. Frost and Campbell vice-presidents, and Mr. Plaskett, of the Dominion Observatory, was elected a councillor. A great number of papers were read during the five sessions held on August 23, 24, and 25, and the general feeling was that in every respect this twelfth annual meeting was eminently successful. We briefly note a few of the papers here.

Prof. Pickering read a paper in connection with the symposium on photographic astrometry, showing how the first point of Aries might be determined photographically.

Miss Cannon announced that the spectra of 762 double stars of magnitude 7·5 and brighter had been especially examined on the Harvard photographs, and also explained that an examination of some 131 stellar spectrograms taken with slit spectrographs was being made, in order to see whether the same system of classification can be applied to such spectra as was applied to the store of objective-prism spectra at Harvard. It is difficult to see why the classification should differ, although more details may be seen and so give finer divisions; but we hope that this work will not lead to further complications in the already complicated nomenclature of the Harvard system.

Mr. Parkhurst examined a number of stars given in a list by Prof. Pickering purporting to comprise "Fourth Type Stars not Red" (class R), and extended to include some ordinary red stars (class N). By his photo-visual magnitude method he finds that with one exception the stars are all redder than Aldebaran, and therefore no sharp line should be drawn between classes R and N.

Mr. Harper, of the Dominion Observatory, read a paper on the orbits of the spectroscopic components of d Bootis, and Mr. Joel Stebbins explained how the selenium photometer had revealed a range of 0·2 mag. in the brightness of Betelgeuse during 1910–11, and had shown δ Orionis (range 0·10 mag.) and β Aurigæ (range $<$0·10 mag.) to be eclipsing variables. Polaris too, as shown by Mr. E. S. King's examination of Harvard plates, has a variability of 0·108 mag.

Some results of a study of visual binary stars by Dr. H. N. Russell suggest that the whiter stars are very much brighter, for equal masses, than the redder stars, and that the stars of a given type are of equal mass and of equal luminosity. Examining some 349 stars of various spectral types, he finds that about half of them are very much brighter in proportion to their mass than the others. This half includes all the stars of the B type, among those examined, and some of every other type, and these stars may probably be classed as the "giant" stars of Hertzsprung's division, a class in which the systems are more or less uniformly of about ten times the sun's mass; no such uniformity is found in the average masses of the "dwarf" stars, which appear, in the average, to become less massive as they become redder. A pair of "giant" stars would emit some 150 to 250 times the light emitted by the sun—the higher value being for class B stars—whereas a pair of "dwarfs" if of the A class might give 30 times, and if of the K_5, or M, class, one-hundredth, the light emitted by the sun.

The 6-inch transit circle of the U.S. Naval Observatory has attacked its programme of fundamental stars, both the old ones and those for the International Chart, and its behaviour was described by Prof. Littell.

Dr. Humphrey's papers showed (1) that the various zones of the earth are not equally efficient radiators; both the

[1] Condensed from the secretary's report in *Science*, N.S., vol. xxxiv., No. 877, pp. 520–536.

equatorial and the polar zones are inefficient as compared with the middle latitude: this result is produced by the unequal distribution of cirrus clouds, which are the effective factors in determining the outgoing radiation; (2) where d is the depth of the water layer in millimetres, and e the partial pressure of the water vapour in millimetres of mercury, the thickness that would accrue if all the water vapour above any given level in the atmosphere, on cloudless days, were condensed, is expressed approximately by $d=2e$; this is some 13 per cent. less than the value, Hann's, heretofore commonly employed in bolometric work.

The reality of astronomical teaching in America was well illustrated by a thoughtful paper by Prof. Sarah F. Whiting, in which she urged the importance of daytime laboratory work in astronomy.

Prof. Very explained an attempt to form a standardised scale of intensities for the lines in the solar spectrum, and Miss Leavitt contributed a paper on the variable stars in the Small Magellanic Cloud; the stars are too faint for our present spectroscopic equipments, but the spectroscopic investigation of brighter stars having similar light-curves—*e.g.* UY Cygni—might prove very profitable. Prof. S. A. Mitchell described the radial velocities of 96 Herculis, which has four components, all measurable on some plates; the velocities range from -98 to $+74$ km. per sec. and the period is 50·2 days.

Prof. Tucker's description of the San Luis Observatory of the Carnegie Institution produces a feeling somewhat akin to envy for the facilities afforded by such an institution. The expedition left New York in August, 1908, and six months later the observatory and a dwelling for the ten observers were completed. Observations with the Pistor and Martins meridian circle of the Dudley Observatory were commenced in April, 1909, and 87,000 observations were completed when the work was brought to a close in January this year; the reductions will be completed at the Dudley Observatory.

The preliminary work done at the Dominion Observatory, sharing in the international cooperative scheme, on the rotation of the sun was explained by Mr. Plaskett. The mean of twenty-three plates taken during June and July this year gives an equatorial velocity of $2{\cdot}034 \pm 0{\cdot}004$ km., the probable error of a single plate being $\pm 0{\cdot}017$ km.; all the elements represented between λ 5500 and λ 5700 appear to share in a common velocity.

Halley's comet was the subject of papers by Prof. Barnard and Prof. Frost, respectively, the former giving the preliminary results determined from Mr. Ellerman's photographs taken at Hawaii, the second finding $+55$ km. per sec. as the radial velocity of the comet on May 24, 1910; this value was obtained from measurements of the displacements of the Fraunhofer lines, and agrees, within 1 km., with the value given by the ephemeris.

Dr. Slocum described the spectroscopic effects produced by the large solar prominence of October 10, 1910. The prominence rose to a height of 105,000 km., and the local relative displacement of the absorption and emission lines represented a radial velocity of 15 km. per sec. Dr. O. J. Lee finds that, for reversal, the lines λ 4427 and H (λ 3968) require vapour densities one-seventh and 1·5 times as great, respectively, as that necessary for the reversal of K, when the vapour is observed at 2500° C. and at atmospheric pressure.

Prof. S. I. Bailey discussed the magnitudes of the stars in the cluster Messier 3, the discussion being based on a photograph, taken by Ritchey with the 60-inch reflector, showing some 30,000 stars down to magnitude 21·5: the total light of 2542 stars the magnitudes of which were determined is approximately equal to that of a star of magnitude 10·4. Dr. Albrecht reported on his work in determining the effective wave-lengths of lines in various types of stellar spectra, and also reported the results secured in a determination of the definite wave-lengths of the silicon lines at $\lambda\lambda$ 4552·7, 4567·9, and 4574·9 in stellar and in laboratory spectra. His stellar values are 4552·762, 4567·967, and 4574·918 respectively, and these are compared with similar values obtained by Gill and McClean, and laboratory values secured by Exner and Haschek, Frost and Brown, Lockyer, and Lunt. He emphasises the necessity for more laboratory work in order to investigate the causes producing the present lack of close agreement. In a third paper the same worker directs attention to the grave importance of investigating the change of wave-length of fundamental lines in passing from one spectral type to another. Such differences might, *inter alia*, account for certain systematic errors in the wave-length of the B type stars, and the elimination of these errors might directly affect the position of stars of this type in any discussion of the structure of the universe.

The list of papers concluded with one by Dr. Russell dealing with the photographic determination of the moon's position, a note on the five Ellicott astronomical instruments which were constructed about 1780–90 and are now on view in the U.S. National Museum, and a report from the committee on photographic astrometry. The resolutions of the latter strongly express the opinion that photographic methods can be applied successfully to absolute, as well as to differential, determinations of star positions, thereby gaining the advantage of independent observations with instruments of entirely different characters.

BIOMETRICIANS AS ANTHROPOLOGISTS.

IT is only necessary to turn to the current issue of *Biometrika* [1] to see the extent to which modern biometricians are devoting themselves to anthropology. About two years ago Dr. Crewdson Bennington died, leaving behind him a mass of observations and notes he had made in connection with the biometrical laboratory of University College. Prof. Pearson has systematised Dr. Bennington's observations and notes, and with the help of other workers in his laboratory brought Dr. Bennington's work to completion.

Dr. Bennington's aim was to obtain type-contours of the skull and of the living head of various races of mankind—contours which might serve as racial types. For instance, exact tracings were made in three planes of 100 crania of ancient Egyptian men. These contours were plotted out and combined by a method suggested by Prof. Pearson, and in this manner type contours were obtained for the ancient Egyptians of the twenty-sixth and thirtieth dynasties.

The results which interest us most are those contours prepared from the Whitechapel plague-pit skulls (seventeenth century) and those made from the heads of 118 men of the Royal Engineers of the present day. When these ancient and modern forms are compared, Prof. Pearson finds that there is no reason to believe that there is "any substantial difference between the English head of to-day and our plague-pit crania, which we have been told are not typical English." The editor of *Biometrika* has issued with this paper copies of Dr. Bennington's type-contours on transparent paper, so that they can be utilised by other workers for purposes of comparison.

Besides the important paper just noted, in parts i.–ii. of *Biometrika* there are others which will prove of value to the student of mankind. Dr. David Macdonald's inquiry seems to show that the acute infections of childhood favour the children with dark skin and eyes; they survive the effects of infection better than children with fair skin and blue eyes; the dark-skinned children are therefore being preserved or selected. Dr. Schuster's observations on the undergraduates of Oxford show that the students there have longer and narrower heads than those at Cambridge or at Aberdeen. The Oxford men are also considerably taller. Another important anthropological paper in the same number is Mr. J. I. Craig's "Anthropometry of Modern Egyptians."

ROCK CRYSTAL: ITS STRUCTURE AND USES.[2]

ROCK crystal, quartz, the common crystallised form of dioxide of silicon SiO_2, is, from many points of view, the most interesting of all minerals and the most instructive example of crystalline structure known to us. "What is a crystal?" The evidence is now overwhelmingly complete that a crystal is a homogeneous structure built up on the plan of a space-lattice, each of the unit

[1] *Biometrika*, parts i. and ii., July, 1911. Edited by Prof. Karl Pearson. Price 20*s*. net.

[2] From four Cantor Lectures delivered in May, 1911, to the Royal Society of Arts by Dr. Alfred E. H. Tutton, F.R.S.

cells of which is the habitat of a chemical molecule of the substance of which the crystal is composed, and of which it is the most highly organised solid form. It was shown by Frankenheim and Bravais that there are fourteen such space-lattices possible, all of which exhibit the full symmetry of one or other of the seven crystal systems, the cubic, trigonal, tetragonal, hexagonal, rhombic, monoclinic,

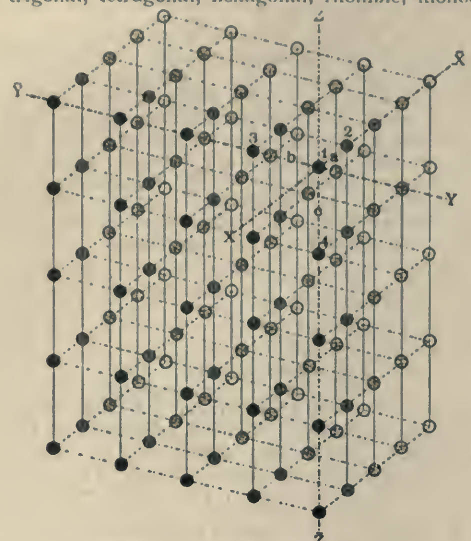


FIG. 1.—Triclinic Space-lattice.

or triclinic. As a typical example of a space-lattice, and the one of most general form, the triclinic space-lattice is shown in Fig. 1.

But the chemical molecules, the arrangement of which thus determines the crystal system, are not the ultimate units, being composed of elementary atoms, and it is the arrangement of these latter, the ultimate structural units, which determines the class of the system.

Quartz crystallises in the trigonal system of symmetry. It does not develop, however, the full holohedral trigonal symmetry, but that of the trapezohedral class of the system, no plane of symmetry being present, and the three digonal axes of symmetry occupying positions in the horizontal plane midway between those of the holohedral class.

Now in the most general case six faces are required to be present by the symmetry elements in operation, when one face is given as present, and they make up a double

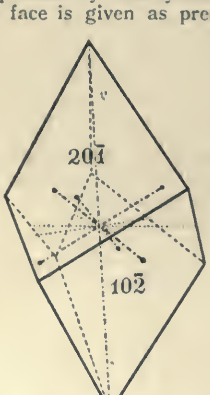


FIG. 2.—Right Trigonal Trapezohedron.

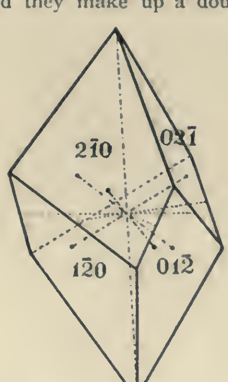


FIG. 3.—Left Trigonal Trapezohedron.

trigonal pyramid, of which the lower half is rotated somewhat with respect to the upper, screw-wise, the solid thus produced being known as a trigonal trapezohedron.

In actual fact two such trigonal trapezohedra, which are the mirror-images of each other, are possible, and the two solids are quite distinct, for no amount of rotation will bring either to resemble the other. That corresponding to Fig. 2 is called the right trigonal trapezohedron, and that represented by Fig. 3 the left variety. This fundamental fact respecting the general form of this class of trigonal symmetry affords the explanation of the two varieties, right- and left-handed, of quartz, which mineral shows characteristic development, in the well-known little *x* faces, of the two trapezohedra.

Two characteristic crystals of quartz, a right-handed and a left-handed one, are shown in Figs. 4 and 5, on which the small faces *x* are those of the right and left trigonal trapezohedra respectively. Also, the little adjoining faces *s* are those of another pair of mirror-image complementary forms of the trapezohedral class of trigonal symmetry, the right and left trigonal bipyramids. The other faces shown on Figs. 4 and 5 are those of the hexagonal prism *m*, a form common to both the hexagonal and trigonal systems, and also common to both varieties of crystals of the trigonal trapezohedral class; also those of the two complementary rhombohedra *r* and *r'*, which together make up what appears to be the hexagonal pyramid terminating each end of a fully-developed quartz crystal. Alternate faces of the pyramid belong, however, to different rhombohedra, three to *r* and three to *r'*; and they are often characteristically different, either in amount of development or in polish, the faces of the rhombohedron *r* being much more brilliant than those of *r'*. Moreover, the quartz crystals from a particular locality in Ireland show one rhombohedron only, without a trace of the other.

It will be observed, further, that the little *s* and *x* faces occur replacing right solid angles on a right-handed crystal, and left solid angles on a left-handed crystal. Also, if *x* faces be absent, a good little *s* face is often present, and

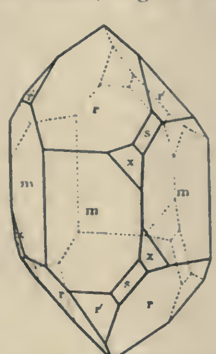


FIG. 4.—Right-handed Quartz.

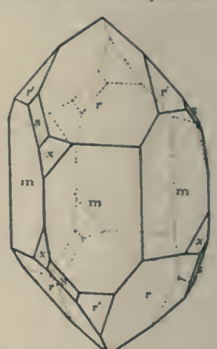


FIG. 5.—Left-handed Quartz.

it is usually marked by striæ parallel to the edge *sr*, which enable the location of the face, and its nature, to be recognised.

We are next attracted by the further problem of the internal structure, which is the prime cause of this outward development. The evidence afforded by cleavage is very emphatic, in spite of the fact that quartz cleaves only with the greatest difficulty. Indeed, this difficulty of provoking cleavage in quartz enhances wonderfully the importance and use of the mineral, both for scientific and industrial purposes, for it enables lenses, prisms, and plates of this clear, transparent mineral to be cut, ground, and polished with the greatest ease, without risk of flaw. But when a quartz crystal is heated, and then suddenly cooled by plunging it into cold water, it breaks up into rhombohedra closely resembling cubes, the angle of which is 85° 46', that of the primary rhombohedron *r* of Figs. 4 and 5. Now it is interesting, also, that simple apparent cubes, really these rhombohedra, of quartz are occasionally discovered, quite a number having been found in the neighbourhood of Bristol.

These facts not only confirm the trigonal, as distinguished from possible hexagonal, symmetry of quartz, but also indicate that the space-lattice structure present is that of the rhombohedron, the elementary cell of which is represented in Fig. 6.

Thus we conclude that if each molecule SiO_2 were represented by a point, the points would be arranged in the form of a rhombohedral space-lattice having the angle of the rhombohedron of quartz, 85° 46'.

If we take, next, a hexagonal section of a prism of

quartz and heat it gently and evenly over a small Bunsen flame or other source of heat, and then allow it to cool, electrical excitation is developed, positive and negative electricity being produced, respectively, at alternate corners of the hexagon. Now the three digonal axes of symmetry emerge at the six corners, and the little trigonal pyramid and trapezohedron faces *s* and *x* are present at alternate corners corresponding to one end only of each axis; and it is interesting that these corners where the little distinctive faces are present are those which become negatively electrified, while those corners where no *s* and *x* faces are developed become positively electrified. This disposition of the pyroelectric poles is precisely in accordance with the symmetry of the trapezohedral class of trigonal symmetry.

If we treat a pair of quartz crystals, right- and left-handed respectively, with a small quantity of aqueous hydrofluoric acid, a chemical solvent for silica, characteristic little markings, or "etch-figures," are produced on the faces. They are little depressions, of the shape of a candle flame blown to one side by a draught of air, to the right on a right-handed crystal and to the left on a left-handed crystal, and are pointing upwards and downwards, respectively, on alternate faces. Thus we have trigonal rather than hexagonal symmetry again demonstrated, and a screw structure, clockwise in one variety and anti-clockwise in the other, such as corresponds to the trapezohedral class of the trigonal system, also most clearly indicated.

Now it has been definitely proved that specific atoms of the chemical molecule are definitely orientated in the crystal, and that if such atoms, say those of potassium or of sulphur in potassium sulphate, be replaced by others of the same family group of chemical elements, for instance, the potassium by rubidium or cæsium, and the sulphur by selenium, specific directional changes in the crystal angles are observed to occur. In the cases just referred to, the replacement of the metal brings about an alteration in the length of the vertical axis of the rhombic crystal of the sulphate or selenate, while replacement of the sulphur by selenium causes an equatorial change. If, therefore, we accept the view of Barlow, and represent the atoms by their spheres of influence, we are only logically following up this important experimental fact.

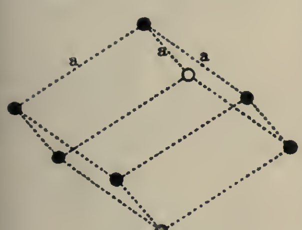


FIG. 6.—Unit Cell of Rhombohedral Space-lattice.

Barlow has recently propounded the view, in collaboration with Pope, that the relative size of the sphere of influence of an atom in any one compound, compared with that of any other atom in the same compound, is intimately connected with the chemical valency of the element, being proportional to the fundamental valency. This is rarely the maximum valency, although in the case of carbon it would appear to be so, atomic spheres of influence of carbon having apparently four times the volume of those of hydrogen or chlorine present in the same compound. The relative size of the atomic sphere of influence of oxygen appears to conform to its usual dyad character. Silicon might, perhaps, from its occurrence in the same family group of elements as carbon, be expected to behave also as a tetrad, but there is much more evidence that its fundamental valency is only dyadic. Now Barlow has shown that if we accept the view that the fundamental valencies of both silicon and oxygen are dyadic, and therefore that the spheres of influence of the two elements in quartz are of the same size, the whole of the properties of quartz can be explained on the assumption that the two structures, right-handed and left-handed, are composed of such assemblages as are shown in Figs. 7 and 8, in which the white spheres represent silicon and the black ones oxygen atoms, there being two of the latter to every one of the former, corresponding to the formula SiO_2.

The helical character is clearly shown by these assemblages of silicon and oxygen atoms, the white spheres of the former being obviously arranged in a right-handed screw in Fig. 7 and in a left-handed helix in Fig. 8, the two arrangements being the mirror-images of each other, as a right-hand glove is to a left-hand one. That some such structural arrangements of the chemical atoms as these are really present in the two varieties of quartz is, indeed, highly probable

The most important and convincing evidence of the right- and left-handed screw structure of quartz is afforded, however, by the optical properties of the mineral.

We may study, first, the effect of passing the light from the lantern, an image of a slit in front of which is focussed on the screen by a lens, through either of two 60° prisms, one cut so that the light passes through the crystal at minimum deviation parallel to the axis, as shown in Fig. 9, and another with the refracting edge parallel to the axis, as shown in Fig. 10. In the latter case we see two spectra on the screen, which are separately extinguished by a large Nicol prism placed in the path of the rays, when rotated to two positions 90° apart; while in the former case only a single spectrum is produced on the screen, and remains permanent when the Nicol is placed in position and rotated, just, in fact, as if the quartz prism were made of glass. This is the mode of cutting quartz prisms employed for use in experiments with ultra-violet light, such as the investigation of the ultra-violet spectrum, quartz being remarkably transparent to these ultra-violet rays of short wave-length, which are entirely cut off by glass.

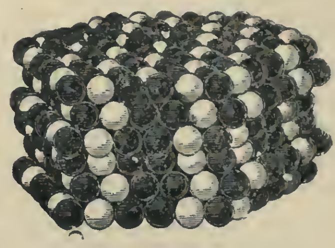


FIG. 7.—Barlow's Conception for Right-handed Quartz.


FIG. 8.—Barlow's Conception for Left-handed Quartz.

We may next investigate plates of quartz in polarised light. Placing a plate of quartz 1 millimetre thick in the polariscope arranged for convergent light, we perceive a more or less normal uniaxial figure, although the rings are large and diffuse and the dark cross present is also very diffuse. If we now take a thicker plate, conveniently one 3·75 millimetres thick, the coloured rings are more numerous, the innermost being smaller; the arms of the cross are also sharper near the margin of the field, but they have entirely disappeared from the centre of the figure, and the whole of the interior of the innermost ring is filled instead with yellow light. Moreover, if we rotate the analysing Nicol clockwise, this ring expands if the plate has been cut from a right-handed crystal of quartz, but contracts if the crystal be a left-handed one, the circular nature of the ring also altering until it is nearly square. If, now, we superpose two such plates 3·75 millimetres thick, one of right-handed quartz and the other of left-

FIG. 9.—60° Prism Cut for Light to Traverse Axis.

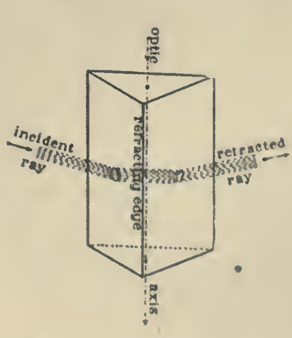


FIG. 10.—60° Prism with Refracting Edge Parallel Axis.

handed, we obtain a remarkable change in the figure, namely, the production of the celebrated spirals of Airy.

Now these phenomena suggest a spiral, and a complementarily helical, arrangement of the atoms composing the chemical molecules of silica in the two forms of quartz crystals. That the supposition is correct may be proved, as first shown by Reusch, by reproducing the effects by means of a spirally arranged pile of biaxial mica films. Twenty-four equally thin films of ordinary muscovite mica are laid over each other so that the direction of the line joining the two optic axes of the mica regularly rotates by the same angle, conveniently 60°. The biaxial figure normally given by muscovite mica will be found, on placing the pile in the polariscope, to have been converted into a uniaxial one. Moreover, the figure resembles that afforded by quartz to a remarkable degree of precision, for if the pile be a right-handed one the figure is similar to that afforded by right-handed quartz, and gives the same effects on rotating the analyser; whereas, if the pile had been arranged in a left-handed manner, the effects would resemble those afforded by a plate of left-handed quartz. Further, if we superpose the two piles of mica plates, the left-handed and the right-handed, and place them together in the polariscope, Airy's spirals are at once produced on the screen.

Let us now study quartz plates in a parallel beam of polarised light. If we take two plates, one of right-handed quartz and the other of left-handed, each of 7·5 millimetres thickness, we find that they each give with crossed Nicols the well-known rose-violet tint of passage between the first and second orders of Newton's spectra. But on rotating the analysing Nicol clockwise, the right-handed plate changes colour first to red, then to orange, yellow, green, and blue, while the left-handed plate becomes first blue, then passes through green and yellow to orange and red.

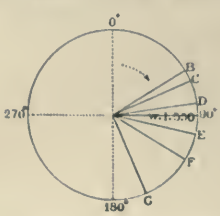


FIG. 11.—Rotations by 3·75 mm. of Quartz.

FIG. 12.—Rotations by 7·5 mm. of Quartz.

On the other hand, the two plates of 3·75 millimetres thickness appear yellow under crossed Nicols, just as were the centres of the interference figures in convergent polarised light, and they change colour in opposite directions of the spectrum on rotating the analyser, until they become violet with the tint of passage when the Nicols are parallel.

Now all these beautiful phenomena are due to the fact that when a beam of light is sent along the axis of a quartz crystal, the right- or left-handed arrangement of the molecules of silica causes the plane of vibration of the polarised light received from the polarising Nicol to be rotated in the same direction, the amount being directly proportional to the thickness of the plate. It also varies considerably with the wave-length of the light. For plates of 3·75 and 7·5 millimetres thickness, respectively, the rotations by plates 1 millimetre thick are indicated in Figs. 11 and 12. Fig. 11 shows that the plane of vibration of yellow light of wave-length 0·000550 is rotated just 90° by a plate of 3·75 millimetres thickness, and this explains the production of the violet tint of passage when we have rotated the analysing Nicol 90°, that is, until it is parallel to the polarising Nicol. For the extinction of this yellow light leaves the complementary colour, the violet transition tint, predominant. And when we double the thickness of the plate to 7·5 millimetres, the yellow ray, of 0·000550 millimetre wave-length, is rotated just 180°, as shown in Fig. 12, which, when followed (by rotation of the analyser), brings the Nicols into the crossed position again, and thus the violet transition tint is at once given by such a plate under crossed Nicols.

The colour produced by thick plates of quartz in polarised light is thus due to optical rotation, and it is quite as brilliant as that due to double refraction shown by thin plates of quartz, such as those of rock-sections, which vary from a twenty-fifth to a fiftieth of a millimetre in thickness. The phenomenon of optical activity is confined to crystals belonging to those eleven classes of symmetry which exhibit right- and left-handed forms, that is, in which there is no plane of symmetry developed.

Now besides the right- and left-handed forms, showing dextro and lævo rotation, chemists have discovered many cases in which the optical activity is either neutralised or destroyed by intimate lamellar twinning of the two complementary varieties, or by chemical combination of the two sets of molecules in which the atoms are oppositely spirally arranged. In the former case of regularly repeated twinning the symmetry is apparently enhanced by the introduction of a plane of symmetry, the composite crystal showing the characteristic faces of both right- and left-handed forms. In the latter case chemical combination results in the production of a new substance, and the crystalline form is altogether different, and may even belong to another system. This is the case with tartaric acid, for the combination of the two sets of molecules produces racemic acid, which crystallises in the triclinic system with a molecule of water of crystallisation, totally unlike the crystals of either ordinary dextro (right-handed) tartaric acid or the complementary lævo (left-handed) tartaric acid, both of which belong to the sphenoidal class of the monoclinic system, and are anhydrous.

Now the racemic form of optical inactivity is often

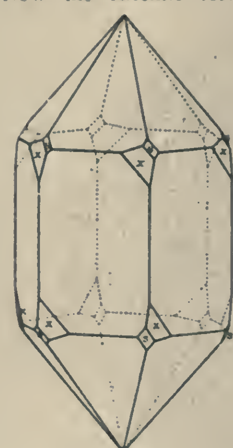


FIG. 13.

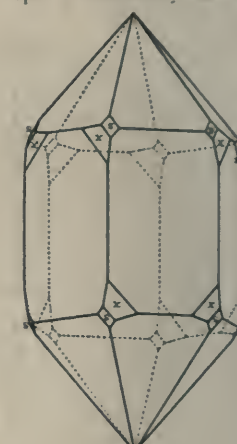


FIG. 14.

The Two Types of Quartz Twins.

simulated to a most remarkable extent by the repeated twinning already referred to; but such a "pseudo-racemic" form can generally be readily distinguished from a truly racemic form by the fact that it still exhibits the symmetry of the same system, although that of a class of higher symmetry in the system, owing to the introduction of a plane of symmetry, about which the twinned individuals are disposed in mirror-image fashion. This case of the mechanical enhancement of the symmetry by repetition twinning is beautifully illustrated by quartz, especially in the exquisite form of the mineral known as twins, one, illustrated in Fig. 13, in which the two individuals are of the same right- or left-handed variety, and another, represented in Fig. 14 by an example in which also complete interpenetration has occurred, in which a right-handed crystal is twinned with a left-handed one.

This latter kind of quartz twin is frequently found occurring among specimens from Brazil. The twin plane is a face of the hexagonal prism of the second order, perpendicular to a pair of the faces of the hexagonal prism present, which is of the first order. The little *s* and *x* faces are shown on every corner, as in the case of Fig. 13, but symmetrically.

Now if a plate of such a crystal be cut perpendicularly to the axis, the polarisation phenomena, due to the opposite optical activity of the two different varieties present, will vary according to their mode of internal disposition. When the whole of one half of the crystal is of right-handed and the other of left-handed quartz, and the surface of junction is a plane parallel to the axis, we have a natural biquartz

produced on cutting such a section-plate which shows absolutely no trace of a junction-plane in ordinary light or when the Nicols are crossed or parallel, but exhibits different colours in the two halves the moment either Nicol is rotated to even the slightest extent.

If the plane of junction be oblique, however, the biquartz shows a black band between the two halves when the Nicols are crossed, and a white one when they are parallel, as in the case of a natural biquartz projected on the screen, the obliquity of the junction plane in which is not great. When the junction-plane is of greater obliquity, not only the central black band, but a white one and a spectrum on each side of it, are exhibited, as illustrated on the screen by an example.

A very instructive case is that of a natural quartz twin-combination, which by its picture on the screen in polarised light, illustrated in Fig. 15, is seen to be composed of one half of left-handed quartz, which polarises in a rich crimson lake with crossed Nicols, and a second half which is made up of alternating right- and left-handed quartz, the strips being joined obliquely to the plate, so that a black band is produced in each case as the central line of a ribbon, being flanked by a white band and a spectrum band on each side.

Such a banded structure of alternately right- and left-handed quartz affords an instance on a larger scale of the finely laminated twinning of the two varieties present in amethyst. The case of a section-plate of amethyst is an exceedingly beautiful one. The marginal parts show polarisation colours in three sectors, indicating the presence of right- or left-handed quartz. The alternate sectors, however, show a natural violet colour, which is the distinctive feature of most amethysts: hence the name; and in the central part of the plate these sectors exhibit the beautiful laminated twinning effect, under crossed Nicols a delicate slate-coloured line marking the junction of each pair of right and left laminæ, each lamina itself appearing as a thin white band bordered by traces of spectra. On rotating the analysing Nicol the laminæ exhibit the most beautiful shades of greys and browns, with delicate linings of rose and other tints. This central part of the plate, moreover, is unique among quartz crystals in exhibiting a normal uniaxial interference figure in convergent polarised light, that is, with the black cross complete to the centre.

FIG. 15.—Banded Quartz Twinning.

Thus the intimate lamellar twinning of the two varieties of quartz in amethyst results in the production of a crystal which simulates holohedral trigonal symmetry, and is apparently optically inactive, the optical activity of the lower-class pair of varieties being neutralised by their intimate blending. Amethyst, therefore, is not a case of true optical inactivity, but of mechanically and naturally produced pseudo-inactivity. It is thus an excellent illustration on a large scale of the still more intimate blending of microscopic or even submicroscopic laminæ of the two varieties in the organic substances known to chemists as pseudo-racemic compounds, a large number of which have been studied by Kipping and Pope. In many of these cases the blending of the two varieties by regular intercalation and alternation of the two varieties, one within the other, is so intimate that the laminæ approach the molecular dimensions in thinness. It is easy to see that if the approach be continued until this fascinating region of molecular forces be penetrated—for we know that within four or five molecular diameters these intermolecular forces come into play—chemical affinity will be developed with the production of a molecular compound—a racemic compound—of the two varieties, the individuality of each variety being no longer preserved, but a new compound, due to the double molecule, being produced and crystallographically developed according to its own crystalline form.

The investigation of the twinning of quartz, as seen in its most beautiful development in amethyst, has thus enabled us to elucidate some of the most interesting and complicated phenomena of optical rotation and of chemical crystallography.[1]

THE VALUE OF BIRDS TO MAN.[2]

VEGETATION is the prime requisite for the perpetuity of all other forms of life upon the earth. The greatest known enemy to vegetation is insect life, while bird life, by virtue of its predominating insect diet, wields a most important balance of power against the ravages of this the chief pest of vegetation.

The number of insect species is greater by far than that of the species of all other living creatures combined. The voracity of insect life is as astonishing as its power of reproduction. Many caterpillars consume twice their weight in leaves per day, which corresponds to a horse eating daily a ton of hay.

The development of young birds is so rapid, and the demand upon the vitality of older ones so great, that an enormous amount of food is necessary to sustain the vital processes. Digestion is exceedingly rapid in birds; and they feed for the most part throughout the day, especially when rearing young. The number of insects daily passed into the insatiable maws of the nestlings during this period almost exceeds belief. But the most valuable services of the adult bird are rendered when it is feeding in winter or early spring, for then it destroys countless numbers of insects in the embryo state, and thus prevents myriads of depredators from coming forth. Grave and far-reaching results invariably follow the suppression of this perennial regulative influence which is exerted by birds individually everywhere as a check on insect life.

Forest trees have their natural insect foes, to which they give food and shelter; and these insects in turn have their natural enemies among the birds, to which the tree also gives food and shelter. Birds are not only essential to the well-being of the tree, but the tree is necessary to the life of the bird. It is because of this most delicate adjustment between the tree, the insect, and the bird that Mr. Frank M. Chapman's statement "that it can be clearly demonstrated that if we should lose our birds we should also lose our forests," must be regarded as profoundly true. Call the bird in the orchard an evil if you will. But it is a necessary evil, and the fruit-grower must make up his mind to pay the bird its wages, even though at times they may seem exorbitant.

Each season, until hay-making commences, the grass offers cover and shelter for the nests of such birds as breed on the ground. The fields also provide food for birds, and for the insects on which birds feed. Where the birds of the field are undisturbed they tend to hold the grass insects in check. On the other hand, when the numbers of birds in the field are, for any reason, insufficient, the insects increase.

Without birds grass could not be grown. The grub of a single species of beetle, if unchecked, could destroy all the grass roots of our meadows, or any one of the several

[1] The concluding lecture, which concerned the scientific and artistic uses of quartz, does not lend itself to abbreviation, and for an account of it the Journal of the Royal Society of Arts of October 27 (vol. lix., p. 1091) should be consulted.

[2] From a paper read before the British Empire Naturalists' Association on December 1 by James Buckland.

species of cut-worms might be sufficient to destroy all the verdure above ground.

The destructive habits of the small rodents, which are the natural prey of hawks and owls, are much the same all the world round. Here in England—though on account of their small size and secretive habits they are often undiscerned by man's dull eyes—they swarm in such numbers in the fields and hedgerows that the damage they do must prove a steady drain on the resources of the farmer. The number of small rodents eaten by the rapacious birds is almost as remarkable in proportion to their size as is the number of insects eaten by small insectivorous birds.

The young of hawks and owls remain a long time in the nest, and require a great quantity of food. During this period the resources of the parents must be taxed excessively in the effort to satisfy the hunger cravings of their offspring, and it is not to be wondered at if some individuals are forced occasionally to snap up a chicken. But what is the worth of the chicken, or of the young pheasant, occasionally taken compared with the hundreds of thousands of pounds' worth of damage that is wrought in the orchards and fields by rodents that hawks and owls, had they been spared, would have fed upon for the maintenance of their species?

The destruction of the white heron for its scapular plumes has robbed half the world of a bird which is most useful to man. Its loss to India and to China is most serious. It never touches grain, but feeds solely near water and over damp ground, the breeding-places of innumerable batrachians, small crustaceans, and pestiferous insects, all of which directly or indirectly injuriously affect crops in the neighbourhood. The presence of the white heron in the rice-fields, for instance, is distinctly beneficial to the farmer, and rice is one of the most extensively grown crops of India and of China.

Turning to Australia, it may be mentioned that the slaughter of this and other wading birds for their plumage is causing in that country a decline in its fish resources. As these birds grow fewer in numbers, so do the crustaceans that destroy the fish spawn increase in hosts.

The gull is a surface feeder. It may occasionally levy toll on useful fish when they are indiscreet enough to come to the surface of the water, but to say that they do any appreciable injury to the fishery business is absurd. On the other hand, the presence of the gull is essential to man's health. While the bird fulfils many useful minor offices, such as destroying larvæ in land along the seaboard, and in eating enemies of fish that are exposed during low tide, its chief function in the economy of nature is that of scavenger of the harbours and of the littoral, just as vultures are the scavengers of the mainland.

Birds, unquestionably, are one of man's greatest possessions; yet it is just the possession on which he often sets the least value.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—At the meeting of the Senate on December 13 an anonymous gift of 30,000*l.* was announced, to be devoted to the erection at University College of the buildings for the new School of Architecture, resulting from the amalgamation of the architectural department of University College and King's College. Any balance is to be used for providing studios for the teaching of sculpture and the rearrangement of the School of Fine Art and for the Department of Applied Statistics, including the Laboratory of Eugenics. The gift was accepted by the Senate with cordial thanks. The frontage of the new building will be towards Gower Street; and it is expected that the new building, together with the new chemical laboratories, which will be to the north of the college, will much improve the architectural effect of the college buildings.

OXFORD.—The following lectures and practical courses, in addition to those already noticed in NATURE, have been announced for next term, beginning on January 22, 1912. In human anatomy, Prof. A. Thomson will lecture on joints and the muscles which move them, and will give special demonstrations. Demonstrations will also be given by Messrs. Whitnall and Foster. Mr. Dodds-Parker will lecture on the thorax, and Mr. Doyne on the human eye. In the department of comparative anatomy, Prof. Bourne, F.R.S., will lecture on the Echinodermata and on principles of zoology; Mr. E. S. Goodrich, F.R.S., on the general morphology of Vertebrata, Amphibia, Reptilia, and Aves; Mr. G. W. Smith, on elementary zoology. Practical instruction will be given by the professor, assisted by Messrs. Smith, Huxley, and Coventry. Dr. Jenkinson will lecture on the embryology of Chordata and on regeneration. Prof. Gotch, F.R.S., will continue his general course of physiology, and will give advanced lectures on the excitable phenomena of nerve. Dr. Haldane, F.R.S., and Dr. Ramsden will lecture on subjects of the Final Honour examination in physiology; and practical instruction, elementary and advanced, will be given by Dr. Scott, Dr. Vernon, Dr. Ramsden, and Dr. Douglas, together with the professor; the subjects specially dealt with being histology, muscle and nerve, and physiological chemistry.

Prof. Sollas, F.R.S., will give a general course on geology, and will lecture specially on the geology of Europe. Mr. Vaughan will lecture on palæontology and evolution. Prof. Vines, F.R.S., will give courses on botany for students of forestry and agriculture respectively, and a preliminary course for elementary students. Practical instruction at the Botanic Garden will be given by Dr. Church and Mr. Hiley. Prof. Somerville, F.R.S., will lecture on the principles of agriculture and on forest botany, Mr. Curtler on the history and economics of agriculture, and Mr. Morison on agricultural chemistry. Prof. Odling, F.R.S., will lecture on organic chemistry: uric acid and products; Dr. Watts on organic chemistry: terpenes and camphors. Mr. Marsh will continue his course on the history of chemical theory, and Mr. Fisher will lecture on the subjects of the Preliminary examination in chemistry. Dr. Baker, F.R.S., will lecture at Christ Church on the chemistry of the metals. Prof. Bowman and Mr. Barker will lecture and give practical instruction on elementary crystallography and mineralogy.

Lectures will be given and practical work conducted in geography by Prof. Herbertson, Mr. Beckit, Miss MacMunn, and Mr. Crawford. Dr. Grundy will lecture on the historical geography of Greece, and Mr. Munro on that of Canada. Mr. Mackenzie will give advanced instruction in surveying. Mr. Knowles will superintend instruction in physical anthropology, Dr. Schüster will lecture on statistical methods in anthropometry, Mr. H. Balfour on comparative technology, and Mr. Marett on social anthropology. Sir W. Schlich, F.R.S., will lecture on forest valuation and forest management, Mr. Caccia on sylviculture and forest protection, and Mr. Grosvenor on forest zoology.

DR. A. D. IMMS, professor of biology, University of Allahabad, has been appointed forest zoologist to the Government of India, Forest Research Institute, Dehra Dun, United Provinces.

PROF. HENRI BERGSON, professor of philosophy of the Collège de France, has accepted the invitation of the Senatus Academicus of the University of Edinburgh to be Gifford lecturer from October, 1913, to October, 1915.

IT is announced in *Science* that formal distribution has been made of the California property of the late Mr. D. O. Mills. Among other bequests we notice the following:—the American Museum of Natural History, 20,000*l.*; the New York Botanical Garden, 10,000*l.*; and the American Geographical Society, 5000*l.*

A NOTE in *Science* states that the registration of students in several of the larger universities is reported to be as follows:—Columbia, 7429; Chicago, 6466; Minnesota, 5965; Wisconsin, 5538; Pennsylvania, 5389; Michigan, 5381; Cornell, 5104; Illinois, 5118; Harvard, 5028; Nebraska, 4624; California, 3450; and Missouri, 3141.

THE council of Bedford College for Women (University of London) has received donations and promises to the building fund amounting to 8285*l.* This leaves only 1715*l.* to be collected to enable the college to claim the additional grant of 10,000*l.* promised by the London County Council when the fund reaches 60,000*l.*

The council urgently appeals for this balance of 1715*l.* on the further ground that if it is obtained before January 1, 1912, Sir Francis Trippel has undertaken to raise the remaining 30,000*l.*, which will complete the building and endowment scheme.

WE learn from the annual report and statement of accounts for the year 1910–11 of the Livingstone College that it has been decided to inaugurate a Livingstone Centenary Fund in connection with the centenary of the birth of Dr. Livingstone, to take place in 1913. It is proposed to devote the fund to the paying off of the mortgage on the property, the carrying out of certain important improvements in the college premises, and the raising of an endowment. Livingstone College, it will be remembered, was instituted with the object of preparing missionaries and providing them with an elementary medical training.

The fourth annual dinner of old students was held on December 13 in the new Imperial College Union in Prince Consort Road, this being the first occasion on which the new club has been used for such a purpose. Sir Alexander Pedler, president of the Old Students Association, presided, and Mr. J. A. Pease, the President of the Board of Education, was the guest of the evening. In proposing the toast of "The College," Mr. Pease referred to the large number of students who have passed through the college, many of whom are occupying positions as chemists, geologists, engineers, and Government officials, and are doing excellent work. Prof. W. W. Watts, in responding, referred to the relationship between the Royal College of Science, the Royal School of Mines, and the City and Guilds College under the new organisation, and expressed the hope that each will retain its individuality. Prof. Dalby, Dean of the City and Guilds College, proposed the toast of "The Old Students Association," to which the chairman replied. The guests included the Rt. Hon. A. H. D. Acland, Sir Alfred Keogh, Sir Arthur Church, and Prof. Cox.

IN his annual report for the year ending on June 30 last, President Butler, of Columbia University, in New York, summarises the benefactions received during the year by the University over which he presides. The gifts, legacies, and other receipts for designated purposes received during the year amounted to 507,000*l.* Of this great sum, 195,000*l.* was in partial payment of the legacy of the late Mr. J. S. Kennedy, and 138,700*l.* in partial payment of the legacy of the late Mr. G. Crocker. Toward the erection of the philosophy building 33,000*l.* was received from an anonymous donor. Other anonymous gifts of 20,000*l.* and 11,000*l.* were received. Including the gifts to Barnard College and to Teachers College, both of which are associated with the University, the sum total of benefactions for the year very nearly reached 600,000*l.* The grand total of gifts in money alone made to the several corporations included in the University during the last ten years reaches 3,310,000*l.* As indicative of the growth of the University during these ten years, it is interesting to note that while in 1901 the number of professors was 81, in 1911 it has reached 177. In 1901 there were 396 teachers of all grades, but during the present year the number has been 721.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, December 6.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. T. F. **Sibly**: The faulted inlier of Carboniferous Limestone at Upper Vobster (Somerset). The Upper Vobster inlier lies rather less than a mile to the north of the main outcrop of the Carboniferous Limestone of the Mendips. This inlier has been dissected by quarrying operations. The northern and eastern portions are concealed by a covering of Lias, but its width from north to south is little, if at all, greater than 400 yards, while the east-and-west extent of the Carboniferous Limestone is about 1100 yards. The author has arrived at the following conclusions:—The inlier is a lenticular mass of Carboniferous Limestone, grits, and shales, superimposed upon the overfolded strata of the Coal Measures by thrust-movements. It comprises a northern limestone mass and a southern limestone mass, separated by a grit-and-shale mass. The beds of the grit-and-shale mass are in faulted relation to the Carboniferous Limestone. On the northern side, the adjacent beds of limestone represent part of the Seminula zone; on the southern side, the adjacent beds belong to the lower Dibunophyllum zone. In the northern limestone mass, Vobster Quarry exposes more than 500 feet of Seminula beds, overfolded towards the north-west. In the southern limestone mass the strata are locally overfolded northwards. The beds of the grit-and-shale mass comprise quartzites assigned to the Millstone Grit. They also include shales, with intercalated fine-grained sandstones. Possibly this mass includes the lowest beds of the Coal Measures, in addition to a portion of the Millstone Grit. In sections of Carboniferous Limestone, signs of the stresses to which the strata have been subjected are evident. The beds are often distorted, while slickensides and calcite-veins are developed. The occurrence of a lamellibranch fauna at the top of the Seminula zone is recorded.—J. **Romanes**: Geology of a part of Costa Rica. The part of Costa Rica to the west of San José as far as the Pacific coast is dealt with. San José is situated in a valley sloping westwards, and drained by the Rio Grande and its tributaries. The northern boundary of this valley is the chain of recent volcanoes which rise from its floor, while on the south the ground rises abruptly to form the Cerro Candelaria. In this range of mountains are exposures of limestone, marl, &c., together with igneous rocks. An examination of exposures has failed to produce any Cretaceous fossils, while the occurrence of numbers of Balani points to a Tertiary age for the beds. As this limestone stretches across the Atlantic-Pacific watershed, it yields evidence of an interoceanic connection in this area in Tertiary times. Of the igneous rocks, the most interesting feature is the presence of many boulders of monzonite, indicating a plutonic mass in these mountains. The surface of the valley is composed of a thick series of andesitic lavas. On the Pacific coast at Barranca and Manzanilla fossiliferous Tertiary beds are described. These are all marine ashes, and in the Manzanilla district appear to rest unconformably on an older limestone formation. The boulder-clays of Costa Rica are normal river deposits, though, locally, landslides and spheroidal weathering have played an important part.

Linnean Society, December 7.—Dr. D. H. Scott, F.R.S., president, in the chair.—H. N. **Dixon**: Some mosses of New Zealand. Several collectors had contributed to this account, and specially referred to the mosses sent by Mr. W. Gray from Mauriceville, Wairapa, North Island, which were of the highest interest. A new genus was named Tetraphidopsis, Broth. and Dixon.

Royal Astronomical Society, December 8.—Dr. F. W. Dyson, F.R.S., president, in the chair.—Miss Winifred **Gibson**: The errors of measurements on photographic plates. Measures were made with various orientations of the plate, and the results compared. It was concluded that unless a preliminary series of measurements were made, measures with four different orientations would be required, as maintained by M. Lœwy, in order to obtain trustworthy results.—F. Hope **Jones**: The synchronome astronomical regulator. The arrangement was exhibited and described. It consists of a free pendulum with detached gravity escapement, the impulse being given by a lever falling upon a wheel pivoted at the bottom of the pendulum, and reset by the "synchronome" remontoire action. The arc is maintained constant by an inertia device of Mr. Shortt.—H. H. **Turner**: The determination of differential star places by photographic methods. The selection was suggested of many consecutive regions of the same declination and hour-angle on the same plate, with considerable overlap. The present paper was restricted to the consideration of systematic errors, the main discussion of final places being reserved for a future communication.—Prof. **Fowler** showed photographs of the spectrum of comet Brooks, taken by Mr. Slipher at the Lowell Observatory, and of the spectrum of Morehouse's comet.—A fine series of photographs were also shown of comets Brooks and Beljawsky, taken at the Khedivial Observatory, Egypt, by Mr. Knox Shaw.—G. D. C. **Stokes**: A

critical comparison of the overlapping section of the Oxford and Potsdam Astrographic Catalogue. A number of plates covering the richest region of the zone were selected for examination, and forty stars distributed all over the overlapping area, but not too near the edges, were chosen. These stars were between 8·5 mag. and 10 mag., so as to be neither too bright nor too faint to give good images. Two systems for obtaining the required solutions were adopted and investigated, and the results compared, proper motions being taken into account. The author concluded that the astrographic errors must be ascribed as much to erroneous photographic places as to errors of meridian catalogues. The errors in right ascension were smaller than those in declination.

Royal Anthropological Institute, December 12.—John **Gray**: A new perigraph. In recent years anthropologists have come to the conclusion that one of the best methods of determining the racial affinities and differences of two skeletons is to compare the outlines of their skulls and other bones. It is necessary that these outlines should be exact orthographic projections, and for this reason photographs, taken by the ordinary camera, are unsuitable. Various special instruments, known as "perigraphs," have been devised, chiefly by Continental anthropologists, for drawing these outlines, among the best known of which are those of Martin, of Zurich, and Klaatsch, of Breslau. Most of these instruments suffer from certain defects. A new design has been introduced in the two forms of the perigraph, exhibited and described by Mr. Gray, in which advantage is taken of the well-known principle in mechanism that every point in a plate moving parallel to itself describes exactly similar curves. The application of this principle enables the outline to be drawn at one side instead of under or over the skull, and the delicate adjustments of tracer and pencil in the older instruments are rendered unnecessary. By an ingenious application of the stereoscopic principle, Mr. Gray is able in one form of his instrument to draw contour lines, at any height, without touching the skull.

Mathematical Society, December 14.—Dr. H. F. Baker, president, in the chair.—J. W. **Nicholson**: The pressure of radiation on a cylindrical obstacle.—H. **Hilton**: Hermitian invariants of a canonical substitution.—E. W. **Hobson**: The fundamental lemma of the calculus of variations and some related theorems.—W. **Burnside**: The outer isomorphisms of a group.—E. B. **Stouffer**: Invariants of linear differential equations.—J. C. **Fields**: A method of proving certain theorems relating to adjointness.

CAMBRIDGE.

Philosophical Society, November 27.—F. A. **Potts**: A new type of parasitism in the Polychæta. A new genus of the polychæt worms, here named Parasitosyllis, was found by Mr. Cyril Crossland at Zanzibar in 1902 as an ectoparasite on other polychæts and nemertines. Attachment is effected by the permanently protracted pharynx, lined by very thick chitinous layers which penetrate widely into the host, becoming quite inseparable from its tissues. The lumen of the pharynx is very restricted, probably only allowing the passage of fluids, absorbed by the pumping action of the proventriculus.—C. **Shearer**, H. M. **Fuchs**, L. **Doncaster**, and J. **Gray**: The experimental hybridisation of echinoids. (1) General account of the experiments (C. **Shearer**). (2) The chemical control of inheritance in echinoid hybrids (H. M. **Fuchs**). The authors described the results of experiments on the hybridisation of echinoids conducted at Plymouth. From a study of the characters of the late larva, which are much more definite than the early characters used by previous investigators, they showed that the inheritance of the parental characters in the hybrids was strictly maternal. (3) Cytological observations of hybrid echinoid eggs (L. **Doncaster** and J. **Gray**). Cross-fertilised eggs, *Echinus acutus* × *E. esculentus*, *E. esculentus* × *E. acutus*, and *E. acutus* × *E. miliaris*, were examined in the early segmentation stages to discover whether omission of chromosomes such as has been described by Baltzer occurs in these crosses. In *E. esculentus* × *E. acutus* the mitotic figures were quite normal. In the converse cross a varying number of chromosomes swell up and develop vesicles in the late prophase stages. These vesicles may be thrown off or remain attached to the chromosome; when thrown off they are frequently left on the outside of the spindle, and not included in the daughter nuclei. Some at least of the chromosomes which have produced vesicles may subsequently divide and behave normally. In *E. acutus* eggs fertilised by *E. miliaris* a similar but less regular and conspicuous formation of vesicles takes place.—Miss A. **Homer**: Note on the condensation of tryptophane with certain aldehydes. Crystalline derivatives of tryptophane have been prepared by the interaction of its aqueous solution with (*a*) formaldehyde, (*b*) glyoxylic acid, and (*c*) glyoxal. Another derivative has been isolated as the result of (*d*) the local heating of a layer of ether resting on the surface of an aqueous solution of tryptophane. There is an interesting relationship between the substances formed in the reactions (*a*), (*b*), and (*d*). Hydrolysis of the formaldehyde derivative and the action of heat on the glyoxylic derivative result, in each case, in the formation of the compound isolated in the reaction (*d*). The investigation of the properties of these substances has shown that in the Adamkiewicz, or glyoxylic, reaction the substance essential to the production of the violet colour is formaldehyde.

PARIS.

Academy of Sciences, December 4.—M. Armand Gautier in the chair.—H. **Poincaré**: The theory of the *quanta*. A study of the hypothesis deduced by Planck from his study of the law of radiation of black bodies. According to this theory, the elements to which the radiation of incandescent solid bodies would be due could only acquire or lose their energy by abrupt steps. This theory could not be expressed by differential equations; and the author has attempted to obtain the Planck law by other hypotheses with this limitation removed, but with negative results.—L. **Lecornu**: The balancing of motors. The problem of balancing motors arranged as in aëroplanes is more difficult than balancing a motor with parallel cylinders. It is shown that the desired result can be theoretically obtained by the addition of two or three auxiliary masses, fixed to suitable points.—A. **Laveran**: Concerning *Trypanosoma rhodesiense*. A study of the trypanosome discovered in Rhodesia by Stephens and Fantham. From the facts described, particularly the observations which demonstrate that an animal having acquired immunity for *T. gambiense* is infected like a new animal by *T. rhodesiense*, that the last trypanosome cannot be identified with *T. gambiense*. Experiments are in progress having for their object a similar comparison of *T. rhodesiense* with *T. brucei*.—A. **Müntz** and E. **Lainé**: The proportion of carbon dioxide in the air of the Antarctic regions. Samples collected between latitudes 64° and 70° show a mean content of 2·05 parts of carbon dioxide per 10,000, the lowest proportions occurring in the highest latitudes. These researches, and those obtained some time ago in latitude 55°, in the neighbourhood of Cape Horn, afford a striking confirmation of the views of Th. Schlœsing on the exchanges of carbon dioxide between sea water and air.—M. **Lannelongue**: Excavations at the hamlet of Séviac, near Montréal (Gers). Discovery of a big toe in bronze. The excavations have disclosed some mosaics in a good state of preservation. Details are given of a bronze toe which was found on the soil, and is remarkable for its vigour and anatomical exactness. It is surmised that it may be an *ex-voto* annexed to a statue in stone or marble, or it may be a fragment of an important bronze statue.—M. Moureu was elected a member of the section of chemistry in the place of the late M. Troost.—MM. **Schaumasse** and **Javelle**: A new comet discovered by M. Schaumasse at the Observatory of Nice, and observed by MM. Schaumasse and Javelle. This comet was found on November 30 with the bent 40-cm. equatorial, and appears as a circular nebulosity 3′ to 3·5′ diameter, with a badly defined nucleus of about the twelfth magnitude. The apparent positions are given for November 30 and December 1.—E. M. **Antoniadi**: Observations of the planet Jupiter in 1911 with the 83-cm. equatorial of the Observatory of Meudon. A detailed description of the planet is accompanied with five illustrations of points of interest.—H. **Deslandres**: Remarks on the preceding communication and on the utility of the observation of the

planets. The similarity between the disturbances in the atmosphere of Jupiter and the sun is pointed out, and also the importance of extending these observations to other planets.—M. **Tzitzéica**: The R networks.—Maurice **Potron**: Some properties of the linear substitutions with coefficients $\geqq 0$ and their application to the problems of production and wages.—Louis **Roy**: Viscosity in the movement of flexible membranes.—M. **Girousse**: The protection of installations with weak currents against disturbances due to alternating currents. Supplementary to an earlier note on the same subject. The limits between which the electromotive force and frequency of the disturbing current may be varied have been worked out.—A. **Guillet**: The measurements of small displacements by electrical means. The electrical method proposed is based on the mutual induction of two circuits, and is of the same order of delicacy as the micrometer screw or the optical interference method.—H. **Pécheux**: The resistance and thermoelectricity of tantalum. From the examination of three wires of different purity, the conclusion is drawn that the specific resistance and thermoelectric power of the tantalum increased with the purity.—P. **Vaillant**: The variations in the conductivity of a phosphorescent body under the action of light.—J. **Carvallo**: The conductivity of pure ether. By careful purification of the ether and the glass apparatus, the electrical conductivity was reduced to less than one-tenth that found by Schröder. Even this figure is regarded by the author as too high, and he considers that it is impossible to study completely the conductivity of pure ether in glass vessels.—Georges **Meslin**: The use of doubly refracting prisms for obtaining interference fringes.—A. **Lafay**: The phenomenon of Magnus. A study of the effect produced by a current of air directed normally against a cylinder rotating with a very high velocity.—André **Brochet**: Plotting the lines of equal potential in an electrolyser.—Eugène **Fouard**: The mechanism of osmosis. The experiments described are not in accord with the usual interpretation of the isotonic coefficients of de Vries, nor with the views of Girard and Henri.—G. **Urbain** and F. **Bourion**: Europous chloride. Europic chloride, $EuCl_3$, was first prepared in a pure state; this, reduced in a current of hydrogen at a temperature between 400° C. and 450° C., gives the lower chloride $EuCl_2$, the properties of which are described.—P. **Gaubert**: The indices of refraction of mixed liquid crystals.—J. **Tournois**: The formation of embryos in the hop by the action of the pollen of hemp. It has been found that the oosphere of the hop commences to segment under the action of hemp pollen. This development only appears under favourable conditions of nutrition, and even under the best conditions the development is always limited. —Ch. **Gravier**: Sexual dimorphism in the Capitellians.—A. **Vaissière**: The Opisthobranchs and the marseniads of the Gulf of Tadjoutah.—Ed. **Chevreux**: The amphipods of the French Antarctic expeditions.—Mieczyslaw **Oxner**: The biological analysis of a series of experiments concerning the attainment of sexual maturity, regeneration, and inanition in *Lineus ruber* and *L. lacteus*.—R. **Goupil**: Researches on *Amylomyces Rouxii*.—Mlle. **Robert**: The influence of calcium on the development and mineral composition of *Aspergillus niger*. Within the limits of accuracy employed (0·05 mg. calcium) calcium does not appear to have any influence on the development of this mould.—M. **Javillier** and B. **Sauton**: Is iron indispensable to the formation of the conidia of *Aspergillus niger*?—Raphael **Dubois**: Atmolysis.—Léon **Pervinquière**: The geology of the extreme south of Tunis, especially in the neighbourhood of Ghadamès.—Emile **Haug**: The geology of Meounes and Garéoult (Var).—L. **Cayeux**: A comparison between the Huronian iron minerals of the United States and the oolitic iron minerals of France.—J. **Thoulet**: A bathylithological map of the coast of the Gulf of Lyons between Saintes-Maries and Palavas and Cape Creus.—E. **Rothé**: The earthquake of November 16.

December 11.—M. Armand Gautier in the chair.—Ph. **van Tieghem**: Lepidariaceæ, a new family of Inovuleæ. —P. **Villard** and H. **Abraham**: The measurement of explosive potentials between 20,000 and 300,000 volts. Between electrodes formed of planes of very large area, above 30,000 volts, the explosive potential is a linear function of the distance of the electrodes. A similar relation has also been shown to hold for the case of spherical electrodes carried to symmetrical potentials.—Paul **Sabatier** and A. **Mailhe**: The preparation of the alcoholic amines by catalysis. An extension of the general method described in an earlier paper, the catalytic action of thoria upon a mixture of the vapours of the alcohol and ammonia. Isopropyl alcohol gives isopropylamine, with a little di-isopropylamine, and diphenylcarbinol gives aminodiphenylmethane. Numerous amines have been prepared, starting with cyclohexanol and its homologues. A modification of the catalytic process is described in which the ammonia is replaced by a primary amine; good yields of mixed secondary amines are obtained.—F. **Quenisset**: Photographs of the planet Venus obtained at the Observatory of Juvisy. The photographs demonstrate for the first time the existence of spots on the surface of this planet.—Kyrille **Popoff**: A cause which may have an influence on the estimation of the magnitude of stars. It is suggested that the luminosity of that part of the sky in which a star is situated may be a cause of the discrepancy between the visual and photographic determination of magnitude.—Henri **Renan**: Results of the discussion of observations made by MM. Lancelin and Tsatsopoulos for determining by wireless telegraphy the difference of longitude between Paris and Bizerta. The usual method has been modified by the introduction of an automatic recording instrument for the method of passages. The personal equation is greatly reduced, as is shown in a set of observations given. —A. **Soret**: A bilateral magnetic audiphone.—G. **Reboul**: Photographic impressions on copper. A plate of polished copper, after coating with a very thin layer of chloride or bromide by exposure to the vapours of chlorine or bromine, will give a positive after exposure to sunlight under a negative. The image is not permanent, even in the dark. —Jacques **Duclaux**: The absorption of gases by porous bodies.—Daniel **Berthelot** and Henry **Gaudechon**: The stability of various types of smokeless powder towards the ultra-violet rays. It is shown that the ultra-violet rays from a quartz mercury vapour lamp accelerates the spontaneous decomposition of smokeless powders. This promises to be a valuable method of investigating the stability of smokeless powders, supplementing the tests at present in use.—A. **Recoura**: A combination of ferric sulphate and alcohol. Contribution to the constitution of ferric sulphate.—Marcel **Guichard**: The formation and decomposition of anhydrous bodies: the case of iodic anhydride.—A. **Béhal** and A. **Detœuf**: The action of monochlorurea upon ketones. Monochlorurea in aqueous solution gives with ketones good yields of the monochlorketones. The preparation of several of these is described, and also of the corresponding semicarbazones.—P. L. **Viguier**: Some derivatives of tetrolic aldehyde and its acetal.—G. **André**: The soluble substances occurring in the plasma of tubercles of the potato. The pieces of potato were immersed in ether, and the aqueous solution thus expelled collected and analysed for nitrogen, phosphoric acid, and potash.—Leclerc **du Sablon**: The transpiration of cactus plants: the influence of light.—MM. **Desgrez**, P. **Regnier**, and R. **Moog**: The influence of trimethylamine chlorohydrate on the nutritive exchanges. In experiments on guinea-pigs and rabbits trimethylamine chlorohydrate caused a reduction in the nitrogenous secretions and an increase in the destruction of ternary compounds.—C. **Gessard**: The action of salts on the coagulation of the blood. A study of the relations between the diastase and calcium salts.—Lucien **Vallery**: Study of the coagulation of albumin by heat. Consequences from the point of view of the estimation of albumin in the urine. The whole of the albumin is not precipitated by heating either in presence of acids or electrolytes. Higher results are obtained by using Tanret's reagent, and reasons are given for the view that these higher figures are correct.—A. **Marie** and A. **Thooris**: Variations of the xipho-costal angle according to attitudes and human types.—Etienne **Rabaud**: Paracephalian and acephalian monsters.—R. **Anthony** and A. S. **de Santa-Maria**: The evolution of the *gyrus reuniens* in the Primates.—A. **Rochaix** and G. **Colin**: The action of the rays emitted by the quartz mercury vapour lamp upon the colorability of the acid-resisting bacilli. Under the action of these rays the acid-

resisting bacilli in the dry state lose their power of taking stains by the processes of Gram, Much, and Ziehl, but the process is not the same for all, since coloration by Much's method persists after the bacilli cease to stain by the other two methods.—V. **Commont**: Chronology of the protohistoric, Neolithic, and Palæolithic industries, and the stratigraphy of the Holocene and Pleistocene deposits in the north of France.—Attale **Riche**: The lacunæ affecting the lower part of the secondary layers at Crussol (Ardèche) and at the eastern edge of the Central Plateau.

BOOKS RECEIVED.

Modern Microscopy: a Handbook for Beginners and Students. By M. I. Cross and M. J. Cole. Fourth edition. Pp. xvii+325. (London: Baillière, Tindall and Cox.) 6s. net.

Quelques heures dans le Ciel. By Abbé Th. Moreux. Pp. 127. (Paris: A. Fayard.) 1 franc net.

Les Merveilles des Mondes. By Abbé Th. Moreux. Pp. 127. (Paris: A. Fayard.) 1 franc net.

L'Océan aérien. By Abbé Th. Moreux. Pp. 127. (Paris: A. Fayard.) 1 franc net.

Live Stock Journal Almanac, 1912. Pp. 343. (London: Vinton and Co., Ltd.) 1s.

The American Annual of Photography, 1912. Vol. xxvi. Pp. 328. (London: G. Routledge and Sons, Ltd.) 3s. 6d.

The Scientists' Reference Book and Pocket Diary for 1912. Pp. 24+calendar+100. (Manchester: J. Woolley, Sons and Co., Ltd.) 1s. 6d.

Lehrbuch der Experimentalphysik in Elementarer Darstellung. By Dr. A. Berliner. Zweite Auflage. Pp. xvi+720. (Jena: G. Fischer.) 18 marks.

The Classics of International Law:—Iuris et Iudicii Fecialis, sive, Iuris Inter Gentes, et Quæstionum de Eodem Explicatio, &c. By Prof. R. Zouche. Edited by Prof. T. H. Holland. Vol. i. A Reproduction of the First Edition. Pp. xvi+204. Vol. ii. A Translation of the Text. By J. L. Brierly. Pp. xvii+186. (Washington: Carnegie Institution.)

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Siebzehnte Lieferung. Band I., erste Hälfte. Pp. 161–320. (Jena: G. Fischer.) 5 marks.

University of St. Andrews. Five Hundredth Anniversary. Memorial Volume of Scientific Papers contributed by Members of the University. Edited by Profs. W. C. M'Intosh, J. E. A. Steggall, and J. C. Irvine. Pp. xi+354. (Published by the University.)

More Animal Romances. By G. Renshaw. Pp. viii+252. (London and Manchester: Sherratt and Hughes.) 7s. 6d. net.

The Chemistry of the Radio-Elements. By F. Soddy, F.R.S. Pp. v+92. (London: Longmans and Co.) 2s. 6d. net.

Magnetochemie. Beziehungen zwischen magnetischen Eigenschaften und chemischer Natur. By Prof. E. Wedekind. Pp. viii+114. (Berlin: Gebrüder Borntraeger.) 3 marks.

Einführung in die Tropenwelt. Erlebnisse Beobachtungen und Betrachtungen eines Naturforschers auf Ceylon. By Dr. K. Guenther. Pp. x+392. (Leipzig: W. Engelmann.) 4.80 marks.

The Concrete Institute. Transactions and Notes. Vol. iii. Pp. xxxiv+328+plans. (The Concrete Institute.)

Alexander von Humboldt und Charles Darwin. By Prof. W. May. Pp. 54. (Brackwede i. W.: Dr. W. Breitenbach.) 80 pfg.

Who's Who, 1912. Pp. xxvi+2364. (London: A. and C. Black.) 10s. net.

Who's Who Year-book, 1912–13. Pp. vii+168. (London: A. and C. Black.) 1s. net.

The Englishwoman's Year-book and Directory, 1912. Edited by G. E. Mitton. Pp. xxv+390. (London: A. and C. Black.) 2s. 6d. net.

The Writers' and Artists' Year-book, 1912. Pp. vii+138. (London: A. and C. Black.) 1s. net.

The Helicopter Flying-machine. By J. R. Porter. Pp. viii+80. (London: Office of *Aëronautics*.) 3s. 6d. net.

Hazell's Annual for 1912. Edited by H. Hall. Pp. 592. (London: Hazell, Watson and Viney, Ltd.) 3s. 6d. net.

The Thunderweapon in Religion and Folklore: a Study of Comparative Archæology. By Dr. C. Blinkenberg. Pp. xii+122+map. (Cambridge: University Press.) 5s. net.

The Tobacco Habit: its History and Pathology. By H. H. Tidswell. Pp. xii+248. (London: J. and A. Churchill.) 3s. 6d. net.

Poliomyelitis in Relation to the Spread of Infection by Schools. By Dr. F. E. Batten. Pp. 16. (London: J. and A. Churchill.) 1s. net.

Plant Life: a Text-book of Botany for Schools and Colleges. By Prof. E. Warming. Translated from the fourth edition of the Danish by M. M. Rehling and E. M. Thomas. Pp. viii+244. (London: G. Allen and Co., Ltd.) 4s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 21.

LINNEAN SOCIETY, at 8.—Some Annelids of the Thames Valley: Rev. Hilderic Friend.—The Seedling Structure of Leguminosæ: R. C. Compton.—The Internodes of Calamites: Prof. Percy Groom.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Whim Well Copper Mine, West Pilbara, North-West Australia: H. R. Sleeman.—Emeralds: their Mode of Occurrence and Methods of Mining and Extraction in Colombia: C. Olden.—The "Glen" Bismuth Mines, North Queensland: W. C. Walworth Pearce.—Notes on a Simple Method of Separating Rock from Stiff Clays: F. A. Killik.

CONTENTS.

THURSDAY, DECEMBER 28, 1911.

THE SYNTHETIC COLOURING MATTERS.

The Chemistry of the Coal-tar Dyes. By Prof. I. W. Fay. Pp. vi+467. (London: Constable and Co., Ltd., 1911.) Price 16*s*. net.

THE rate of progress in the dyestuff industry is admittedly far more rapid than in any other branch of applied chemistry, and the advances made during the past ten or fifteen years have effected an enormous change in the whole aspect of the subject. Very many dyestuffs of former importance have been abandoned or partially replaced, and hundreds of new dyestuffs have been introduced into commerce. New manufacturing processes have superseded older ones, and considerable improvements have been made in the methods of dyeing and printing. The majority of these advances have been directed towards securing a greater degree of fastness to washing, light, and other agencies. Thus in cotton dyeing the want of fastness of the earlier "substantive" or "salt" dyestuffs soon led to attempts to fix these colours after dyeing, by various methods, such as by diazotisation and combination with phenols, by coupling with diazo-compounds, by treatment with formaldehyde, or by fixation with salts of copper or chromium. The introduction in 1894 of Vidal black, and the enormous extension of the group of "sulphide" dyestuffs which shortly followed, provided the cotton dyer with a class of cheap colouring matters of much greater fastness than those of the "salt" class, which they therefore largely replaced. Again, more recently the newly introduced "vat" dyes of the anthracene and indigoid classes, though at present expensive and difficult to apply, bid fair eventually to supplant the "sulphide" dyestuffs for those purposes, in which the highest degree of fastness is of paramount importance, since many members of this class exhibit a resistance to light and washing surpassing that of any of the older organic dyestuffs. On the theoretical side also considerable progress must be recorded. The constitution of many dyestuffs and dyestuff groups has been elucidated, the mechanism of reactions has been rendered clearer, and our views as to the connection of chemical structure with colour and dyeing properties have been extended.

In the presence of such rapid advances, existing text-books soon become out of date, and in presenting a new work it should be the first aim of the author to render an account of the subject from the most modern point of view. This unfortunately has scarcely been accomplished in the work under review. The author has apparently drawn his material chiefly from the standard text-books, to which indeed he gives full acknowledgment. Original sources, such as the scientific and technical journals or the patent literature, do not seem to have been consulted to any considerable extent. In consequence many important dyestuffs and even entire groups of dyestuffs escape mention, whilst undue space is devoted to the description of others that are now obsolete, and for which a short historical reference would have sufficed. Thus, among the azo-dyestuffs we find no account of those derived from pyrazolone, comprising the light-resisting dyes—tartrazine, fast light yellow, &c.; nor of the more recent chrome-azo colours obtained from orthoamidophenols and orthoamidonaphthols; nor of the valuable class of substantive dyestuffs derived from the 2 : 5 : 7-amidonaphtholsulphonic acid. The very important group of anthracene vat dyestuffs, of which indanthrene blue is the typical representative, is also not mentioned; whilst thioindigo red and thioindigo scarlet are the only vat dyestuffs of the indigoid class which are described.

Even amongst the older dyes we note some curious omissions. Thus no reference is made to the thiazol class, which includes primuline, chloramine yellow, and thioflavine, though this group still retains its importance. Again, the stilbene condensation, by which curcumine yellow and the mikado oranges are produced, is only referred to in connection with the preparation of diamidostilbene disulphonic acid, whilst the reactions for the formation of this substance are represented in a manner now proved by recent investigations to be erroneous. In describing the synthetical methods for the manufacture of indigo, no reference is made to the technically important modification of Heumann's process employed by the Farbwerke Hoechst, which consists in adding sodium amide to the phenylglycine melt. Moreover, the starting point in the Sandmeyer synthesis is not chloral and hydroxylamine but diphenylurea.

In regard to the more theoretical aspects of the subject, we miss any full discussion of the relationship of constitution to colour, beyond the older views of Witt. Paraquinonoid and orthoquinonoid formulæ are frequently used indiscriminately and without explanation. Thus, whilst the paraquinonoid formula is given to Lauth's violet, its tetramethyl derivative, methylene blue, is represented on the same page by an orthoquinonoid structure. Similarly, in the general classification of the dyestuffs only paraquinonoid types are given, whilst in the general text the dyes of the azine, oxazine, and thiazine classes are mostly represented by orthoquinonoid formulæ. The structure assigned to quinoline yellow is the old quinophthalone constitution now abandoned for the indanedione formula. Chrysophenine is a diethylether of brilliant yellow, and does not contain a free hydroxyl group as formerly supposed and here represented. The fastness to alkalis of the dyestuffs of the patent-blue class cannot be due to the suggested intramolecular linkage of the ortho-sulphonic group, since a similar effect is produced by halogen atoms, or even by methyl groups when present in the same position.

Apart from the above defects, which perhaps are more serious from the point of view of the technologist than for the general chemical student, the subject is presented in an interesting and readable form, which should render the volume of utility. The printing of the text and formulæ is unusually clear, and for a work of this kind fairly free from errors.

The dedication of a whole chapter to the "seven food colours" permitted by the United States Government, appears somewhat a waste of space even for American readers.

ARTHUR G. GREEN.

CONSTRUCTIVE BIOLOGY.

Some Neglected Factors in Evolution: an Essay in Constructive Biology. By H. M. Bernard. Edited by Matilda Bernard. Pp. xxi+489. (New York and London: G. P. Putnam's Sons, 1911.) Price 12*s.* 6*d.* net.

MANY who know the late Mr. Bernard's work in other fields—notably on Madreporarian corals, the Apodidæ, the Galeodidæ, and the retina—will be interested in this essay in constructive biology. Mr. Bernard was marked by a resolute independence of thought, and this quality, strengthened by his mathematical and philosophical training, is conspicuous in the book before us, a posthumous work, very carefully edited.

The first part of the volume is an exposition of the protomitomic theory, according to which what are called "cells" are merely form-features of some deeper underlying texture, namely, a fundamental linin-chromatin network. In the retina of vertebrates the author found a continuous network with the nuclei at the nodes. He called this fundamental reticulum in living substance, "the protomitomic network." "The connecting filaments were seen to be continuations of the filaments within the nuclei, so that the latter appeared to be merely special tangles of the filamentous network." In some tissues a large amount of cytoplasmic matter is required for their activities, and this tends to obscure the essential reticular structure; in other tissues the filaments are the most obvious structural elements. According to Mr. Bernard's view, which is expounded in a temperate, scholarly, and ingenious argument, the biological unit—both morphological and physiological—is not the cell, but a node in the reticular linin-chromatin system, a stellate linin-chromatin mass from which filaments radiate. By concentration of chromidia (*i.e.* minute chromatin particles which occur in the nodes of the linin network), rearrangement of filaments, and progressive centripetal differentiation, and the like, the first cells may have arisen. They are like enlarged editions of the chromidial units, capable of a larger "life."

This is not the sort of theory that can be called right or wrong; the question is whether it is useful in the interpretation of cellular structure and function. In a series of chapters the main conception—of a continuous filamentous system with nuclei distributed as centres of functional activity—is cleverly used as a key, not only in regard to structural details of epidermis, nervous system, sense organs, and the like, but also in regard to growth, cell-division, and even heredity. We come at length to the idea that organisms differ from one another in the pattern of their protomitomic networks, which is like the morphological side of Haeckel's idea that organisms differ from one another in the rhythm of their minutest protoplasmic particles or plastidules. It is indeed a fundamental biological conception that an organism is an individualised persistence of a specific activity inseparably associated with a specific structure.

In many of the cells that we are in the habit of looking at we are bound to confess that we cannot see anything of the protomitomic system, and the descriptions given by some of the most expert cytologists are not in favour of the author's view, which is essential to his whole theory, that the filaments of the nuclear network are *continuous* with the network of the cell-body. The suggestion is made that the use of osmic acid is to blame for the modern denial of the unity of the reticulum. Apart from the idea of continuity, it is possible to find in many recent researches some corroboration of the author's emphasis on the extra-nuclear chromatin. We think, for instance, of the modern insistence, due very largely to Richard Hertwig, on the importance of the chromidial (*i.e.* extra-nuclear chromatin) apparatus in the cytoplasm. Or we recall the "plastosomes" of Meves, elementary structures in the cytoplasm, which are regarded as the foundations or primordia of ontogenetic differentiations.

The second part of the book contains the author's theory of evolution. It is very interesting, characteristically fresh and independent, but within the space at our disposal we cannot do more than allude to three of its outstanding features. The first is the idea of a cosmic rhythm, which is akin to a suggestion that Herbert Spencer made, but left undeveloped, that "life on the earth has not progressed uniformly, but in immense undulations." As Mr. Bernard expressed it: "Organic life is seen advancing out of the dim past upon a series of waves"; period succeeds period, each with a higher unit—"each evolutionary period can be described by the same formula, the processes in all cases being essentially the same, although the factors involved become increasingly complex." The first period is that of the chromidial unit, the second that of the cell unit, the third that of the gastræal unit, the fourth that of the annelidan unit, the fifth that of man. One must remember, of course, that even so far back as the Cambrian life had got a long way past the simpler expressions of the annelidan unit.

The second outstanding feature is the author's conviction that the Darwinian theory accounts for detailed adaptation rather than for great advances in *type*, and that the production of new types is describable as a kind of colony-formation. This was the lesson that the author learned from his thirteen years of work on corals. "The physical force of life" has had periodic outbursts of growth leading to the production of homogeneous aggregates, to repeated colony-formation, to "raisings of the level of life," to "altogether new organisation." Many naturalists have pondered over colony-formation, and we are not prepared to accept the statement on p. 299, that "colonies are regarded by them merely as accidental knots in the evolutionary chain, of no value to the chain." We feel sure, for instance, that the veteran zoologist of Jena will heartily agree with the thesis which his esteemed student has developed in chapter xvii., that colony-formation is an essential factor in evolution. What we miss, however, is a recognition of alternating periods of aggregation and integration.

The third distinctive feature in the etiology of this book is the recognition of "a psychic element in life." While "the assumption of a special 'vital force' is a

knot gratuitously tied in the tangled skein of physical and psychical phenomena," and while the author "would deprecate the assumption that the psyche has mixed, in any way, as an integral factor in the machinery of the building processes of the forms of life, or in their daily workings as intricate mechanisms," yet he believes that the psyche has been able to exert an influence on the working by either delaying or hastening it. In this the psyche is like Driesch's "Entelechy," which punctuates the transformations of energy within the body.

THE SENSIBILITY OF THE ALIMENTARY CANAL.

The Goulstonian Lectures on the Sensibility of the Alimentary Canal. Delivered at the Royal College of Physicians on March 14, 16, *and* 21, 1911. By Dr. Arthur F. Hertz. Pp. v+80. (London: Henry Frowde and Hodder and Stoughton, 1911.) Price 5*s*. net.

THE lectureship which was founded by the late Dr. Goulston is annually awarded to one of the newly elected fellows of the Royal College of Physicians, and so forms a channel by means of which a junior member of the medical profession may make what has often proved to be the first of a valuable series of additions to physiological and pathological progress. Dr. Hertz, however, to whom the honour was awarded this year, is already well known to his medical brethren, and has published many papers on various subjects, as well as a book on constipation. It is to him and his colleagues at Guy's Hospital that we owe the work by means of which the X-ray method has been rendered an aid in medical, as it had been previously shown to be in surgical, cases, and during recent months allusions have been made in these columns to the value of such research in elucidating the disorders of the alimentary canal.

In the present volume, in which Dr. Hertz republishes his lectures, he has, however, struck a new note, and deals with the sensations arising from this part of the body.

The martyr to dyspepsia needs no reminding how insistent such sensations may be. The man in perfect health, however, is scarcely cognisant of the existence of his internal organs. In pre-anæsthetic days, surgeons discovered that the majority of the internal structures of the body are insensitive to touch; they can be handled, and even cut or burnt without causing any sensations. Dr. Hertz not only confirms this by his careful experimental and clinical observations, but has further shown that the alimentary canal is, with the exception of the œsophagus and the anal canal, also insensitive to sensations of heat and cold. Contact with alcohol, however, applied to any part gives rise to a subjective sensation of warmth.

But, as already suggested in the mention of the dyspeptic, pain is experienced; this sensation, which is probably the most primitive of the senses, as it is so important for protective purposes in the struggle for existence can be elicited, but its only cause is tension or stretching, which in a milder degree is also the cause of the sensation of fulness. If disease spreads to, or the tension is exerted on, peritoneal structures, the pain may become excruciating. This sensibility varies in different people, and is most marked in those with an irritable nervous system, as in neurasthenia, hypochondriasis, and anæmia. But when visceral pain or discomfort is present, all people are alike in their inability to localise it accurately. It is then that the so-called "referred pains" come to the assistance of the physician. By this one means that areas of skin and subjacent muscle related to the same spinal segments that govern the viscera, are the seat of discomfort, pain, and even of tenderness. This aspect of the subject has been taken up especially by Dr. Henry Head, and it is quite possible to localise an internal disorder by a study of the referred pain. The painful, tender patch may not always be in the immediate vicinity of the affected organ, for in growth the skin area, and the internal viscus which send their messages to the same segment of the spinal cord may become widely separated; for instance, the association of liver trouble and shoulder pain is familiar even to the non-medical reader.

The alimentary canal, though destitute of any true tactile sense, is endowed with certain sensations peculiar to itself, namely, hunger and thirst. These two sensations do not run quite on all fours with each other, and of them Dr. Hertz refers to hunger only. This consists not only in a general sensation of malaise, but a local sense of abdominal emptiness. Dr. Hertz believes that the latter is produced by the motor activity of the stomach and intestines during fasting; and this affects consciousness partly because the action is excessive, and partly because the central nervous system is over-excitable in this condition.

The brochure of which we have attempted this brief and imperfect summary will amply repay careful perusal, and hearty congratulations are due to its author, not only for his accurate and well-devised experimental work and observations, but also for the lucid and interesting way in which he has presented them.

W. D. H.

A NEW PRIMER OF PSYCHOLOGY.

The Essentials of Psychology. By Prof. W. B. Pillsbury. Pp. xi+362. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s*. 6*d*. net.

THE task of writing a good elementary text-book on any science is notoriously arduous, and this is especially the case with so difficult a subject as that of psychology. The ideal writer of such a book would be one whose power of taking a broad and unbiassed view of his subject was guaranteed by a thoroughly sound previous training in mathematics, physiology, and philosophy (metaphysics, logic, ethics, &c.), every one of which sciences is absolutely essential to a competent knowledge of psychology in its full extent at the present day. A writer falling short of this ideal is likely to betray the fact by an unevenness, more or less pronounced, in his treatment of different parts

of the subject. In the case of the present book the unevenness, though not entirely absent, is scarcely apparent. It takes the form of slight inadequacy on the mathematical side, appearing in the brief and not entirely unmisleading account of the measurement of sensation intensities, and more prominently in the long and otherwise excellent chapter on "The Interrelations of Mental Function," where the important method of correlation now in general use for the measurement of these interrelations is not mentioned, and is only referred to indirectly by the quotation, in one sentence, of a research somewhat out of date and certainly not representative.

In other respects, Prof. Pillsbury has written an exceptionally useful and effective book, for which one can safely predict a high degree of popularity among students. The earlier chapters are devoted to a very interesting analysis of the general characteristics of consciousness, such as attention, retention, and association, and the descriptions of perception, memory, reasoning, &c., are all based upon this earlier account, and form the later chapters of the book. The discussions of attention, memory, and imagination, reasoning and work, fatigue and sleep, are exceptionally good, and sum up concisely a great many of the results of modern experimental work on these topics. Perception is not so well done. It is surely incorrect to say that "perceptions always involve centrally aroused sensations or memories, as well as sensations" (p. 157). Evidence from pathology and animal psychology makes dead against this view. Inherited structure of the nervous system, as Prof. Stout suggests, "explains" the function better in such cases, and even in normal human psychology these additional mental images and ideas are largely mythical and unidentifiable by introspection.

Another small point: in the chapter on cutaneous sensations no mention is made of the distinctness of sensations of warmth, coolness, and light touch from those of heat, cold, and heavy touch respectively, although this result, based upon the work of Drs. Head, Rivers, and Sherren, is now three years old and well authenticated. A reference to it would not have conflicted with the elementary character of the book. This is one instance among several of the tendency to ignore important work done by English psychologists, which is more pronounced than it might be in some American and Continental writers.

At the end of each chapter of the book there is a series of "exercises" in experimental introspection, for which one is grateful. They add considerably to its value for class-work. W. B.

NUMBER AND QUANTITY.

Grandeurs et Nombres—Arithmétique Générale. By Prof. E. Dumont. Définitions et Propriétés fondamentales des Grandeurs géométriques et de leurs Mesures; Nombres Naturels, Qualifiés, Complexes, Ternions et Quaternions. Pp. xvii+275. (Paris: A. Hermann et Fils, 1911.) Price 10 francs.

IN mathematics, as in other affairs, a great movement happens now and then which is a kind of revolution; and whenever this occurs there is sure to be a body of stalwart veterans, who refuse to budge from their old position, however untenable or worthless it may be.

M. Dumont's book is an illustration of this familiar fact. So far is he from accepting the modern view of mathematical science that it stirs him to a passionate revolt; he invokes the shades of the old masters, from Archimedes down to Hamilton, and denounces the logicians as conspiring to make mathematics a barren pastime, instead of the instrument of the natural philosopher.

In order to justify his protest, he has attempted to give a theory based on the definition of a number as the ratio of two quantities. As might be expected, he constantly begs the question, and makes a variety of tacit assumptions, far more complicated than those really necessary in applying mathematics to physical phenomena. For instance, he says (p. 7), "To multiply a quantity G by the number A_1/A is to apply to G the same treatment which, applied to A, produces A_1." What is "the same treatment"? G may be a length, and A, A_1 volumes or masses; how can "the same treatment" be defined without begging the whole question at issue? A little further on we read that "it is not always possible to multiply a quantity (*grandeur*) by a number, as we shall see in the theory of quaternions." Here our Don Quixote betrays some sense of discomfort in his antiquated armour; the reason appears subsequently. Length is defined (p. 114) as "une grandeur linéaire relative et orientée . . . qui se développe dans deux sens opposés, à partir d'une origine arbitraire, et dans une direction variable." On p. 195 we read, "the ratio of two vectors or of two angles, thus conceived, is called a quaternion or quaternary number"; after this it is not surprising to find a treatment of quaternions quite needlessly complex, with definitions stated as theorems, and formulæ of the most repellent kind; moreover, we have a separate chapter on "ternions," which are only special cases of quaternions. To make confusion worse confounded, the author writes (a, b denoting vectors) a/b as the equivalent of $b^{-1}a$, and calls it "the ratio of a and b," while $a:b$ is the equivalent of ab^{-1}, and is called "the quotient of a by b." Almost immediately before this we read: "Quant à a/b, on écrira aussi volontiers $a/b=b^{-1}a$ que $a/b=ab^{-1}$"!

M. Dumont expressly denounces the views of his distinguished countrymen Jules Tannery and M. Hadamard; they need no better justification than is unconsciously given by this attempt to prove them wrong. At the same time, some of us will partly sympathise with M. Dumont, although entirely disagreeing with his doctrine. It would indeed be lamentable if mathematics were to be entirely divorced from its physical applications, and simply cultivated as an intellectual game. Fortunately, there is no reason to fear that this will ever be the case; electrical theory alone will continue to attract many of the ablest mathematicians of the time. And however fully we may admit that arithmetical analysis is independent of measurement, we cannot ignore the fact that measurements must precede any physical theory of a mathematical kind. Moreover, the data properly belonging to any physical science are not themselves

mathematical; the business of the mathematician (as Kirchhoff and Pearson have so well pointed out) is to provide, if possible, a descriptive scheme, such, for instance, as the so-called "law" of gravitation and its mathematical consequences, which reduces a complex group of phenomena to an intelligible system. Anything beyond this is metaphysics, and outside the domain of physical science and mathematics as well.

G. B. M.

APPLICATIONS OF PHOTOGRAPHY IN SCIENCE AND TECHNICS.

Angewandte Photographie in Wissenschaft und Technik. Edited by K. W. Wolf-Czapek. In vier Teilen. Pp. xvi+100+37 plates; pp. 119+41 plates; pp. 95+42 plates; pp. 98+37 plates. (Berlin: Union Deutsche Verlagsgesellschaft Zweigniederlassung Berlin, 1911.) Price 20 marks.

THERE is scarcely a science to-day wherein photography is not employed in one form or another, and even our industries make use of it in a host of different ways. So universal has become the adoption of this form of obtaining permanent records of things living and inanimate that specialists have sprung up in all directions who are able to bring to bear a great amount of experience, not only in how to apply photography to the particular case in question, but the most appropriate apparatus and methods to be adopted to secure the best results.

If, for instance, one wishes to launch out in the domain of photomicrography the first step is to find out what has been written on the subject, and then secure a book which is recommended as containing the best methods to be followed. Or, again, the special field of photographing fast-moving objects, like rifle bullets, is one that requires a good deal of attention before satisfactory results can be obtained. It often happens that one wishes to tackle one branch of photographic work which is outside the domain of that to which one is accustomed, and hence there follows an inquiry into the methods, special apparatus, and material required.

Now the work under review is a veritable *vade mecum* in this respect, for it deals, and deals exceedingly well, with the application of photography in practically every important aspect, both in science and the technics. It is only natural that for such a volume to be of value it must necessarily be the work of numerous men, for no one man can have had experience in all the multitude of applications. Herr K. W. Wolf-Czapek has done well therefore in gathering round him a number of workers who are authorities on the branches about which they write, and the result is one that is eminently satisfactory. The book itself contains 407 pages and 159 plates, with 470 illustrations on them, so that the reader will at once gather the fact that both methods and examples are amply illustrated and described. The contents are divided into four parts under general subheads, namely (1) inorganic physical sciences, such as physics, chemistry, astronomy, &c.; (2) organic physical sciences, such as botany, zoology, &c.; (3) technical science, such as photography applied to war, engineering press, &c.; and lastly (4) social problems, as anthropology, criminal statistics, &c. The list of coworkers is too numerous to be given here, but when it is seen the reader can rest content that the text was in good hands. It is interesting to note that the volume was inspired by the International Photographic Exhibition held in Dresden in 1909, and that Herr Wolf-Czapek took the opportunity to utilise the exhibits as the groundwork for the volume.

In addition to a very carefully prepared table of contents, a subject-index and a name-register, the value of the work is considerably enhanced by the large number of references to the literature of the various subjects treated.

AGRICULTURE AND SOILS OF KENT, SURREY, AND SUSSEX.

Board of Agriculture and Fisheries: a Report on the Agriculture and Soils of Kent, Surrey, and Sussex. By A. D. Hall, F.R.S., and Dr. E. J. Russell. Pp. viii+206+56 figures. (London: H.M. Stationery Office, 1911.) Price 2*s.* 6*d.*

A BRIEF introductory account is given of the geological features of the area under consideration. This is followed by a concise account of the agriculture of the three counties as practised at the present day, chief reference being made to the cultivation of hops and fruit, for which this part of England is famous. Attention is also directed to the most important breeds of live stock found in the districts, the Southdown and Romney Marsh sheep receiving special notice.

The latter portion of the report is devoted to the authors' work upon the soils of the three counties. This section contains a valuable record of analyses—both mechanical and chemical—of the soils of the different localities. Messrs. Hall and Russell have taken the geological formations as a basis of work, and find that the analyses of the soils upon each formation exhibit certain common features which mark them off from those of other formations.

By a careful study of the results, it is seen that the mechanical analysis is, in a general way, indicative of the power of the soil to grow particular crops successfully, and a knowledge of the character and proportion of the component particles is frequently sufficient to enable the expert to predict with certainty the suitability of the soil to the cultivation of hops, fruit, roots, wheat, and other cereals. The chemical analyses in many instances also clearly indicate the need for particular fertilisers, and practical recommendations are made for the manuring of the various farm crops when grown on land situated on the different geological formations.

The authors modestly suggest that the report is incomplete and fragmentary. It is, however, one of the most valuable contributions made to the study of soils in this country, and it is to be hoped that some effort will be made to secure a continuance of similar work in other areas and on an extended scale. We should like to see the analysis of soils undertaken in conjunction with carefully planned experiments upon the actual fields from which the samples are drawn,

the experiments to be continued on the same plots for a period of not less than ten years. If this were done at, say, 500 to 1000 centres, we venture to think that a vast step forward would be made; the interpretation of the figures of soil analysis would become more precise than it is at present, and the relationship between soil texture and composition and its productive power or capacity to grow crops would be more clearly understood. J. P.

OUR BOOK SHELF.

An Account of the Crustacea of Norway. By Prof. G. O. Sars. Vols. i.–v. Vol. v., Copepoda Harpacticoida. Pp. 449+284 plates. (Bergen: Published by the Bergen Museum, 1890–1911.)

By the publication of the concluding parts of vol. v., Prof. Sars has now provided us with the first adequate account of the harpacticoid Copepoda. It was perhaps natural that pelagic Copepoda should first attract the attention of investigators, but many zoologists still appear to think that such forms constitute the principal representatives of the group. This is by no means the case, but perhaps on account of this erroneous impression, the Harpacticoida and other bottom forms have been very much neglected.

An examination of the present volume at once suggests that we still have much to learn of this interesting assemblage. The author gives descriptions of no fewer than 291 species belonging to 99 genera, but at the same time he tells us in his preface that his latest excursion in the summer of 1910 produced about forty additional species, many of them new to science, and most of them obtained in a single locality. This is sufficient evidence that a great deal yet remains to be done, and indeed it is only on the British coast, in addition to that of Scandinavia, that the true bottom forms have been seriously studied, in spite of their considerable economic importance.

It is a matter of some satisfaction that countrymen of our own are among the foremost authorities quoted by Prof. Sars, but this is primarily an indication that these particular forms have been little investigated elsewhere. The abundant large-scale drawings which illustrate each species afford in themselves a most trustworthy means of identification, and it is to be hoped that with such a convenient book of reference now available, a much more extended survey of the types living on the sea bottom will be attempted. We congratulate the veteran author on the successful completion of another volume, and the scientific public on the steady growth of this very valuable work.

W. A. CUNNINGTON.

Traité de Chimie Générale. By Prof. W. Nernst. Ouvrage traduit sur la 6e édition allemande par Prof. A. Corvisy. Deuxième Partie, "Transformations de la Matière et de l'Énergie." Pp. 422. (Paris: A. Herman et Fils, 1912.) Price 10 francs.

The issue of the translation in two parts is to be commended, for the original has grown to such an extent in passing through its six editions that a single volume would be of inconvenient dimensions. It is only quite recently that an English version, revised in accordance with the sixth German edition, made its appearance, and was reviewed in these columns. In these circumstances, it need only be said in reference to the general character of the book that the translator's work in the second volume is of the same high standard as that attained in vol. i.

With regard to the treatment of the subject-matter, attention may be directed to the question of catalysis. In explanation of the general catalytic activity of acids it is assumed, as usual, that the active agents are the free hydrogen ions. It is true that many of the older observations relating to the catalytic activity of acids can be accounted for on this theory if certain subsidiary hypotheses are accepted, but this apparent harmony between theory and experiment vanishes as soon as we leave the domain of aqueous solutions. Recent work has indeed shown that the catalytic activity of acids in non-ionising solvents is much greater than in aqueous or other ionising media, and this important fact cannot be reconciled with the usual ionic explanation of acid catalysis. In view of the importance of the question, the lack of any reference to such observations must be regarded as a serious omission in a treatise which, in so many other respects, may be considered as efficiently revised in accordance with the progress of physico-chemical science.

In regard to the much-discussed question of the nature of crystalline liquids, the author gives an excellent short summary, but considers that none of the theories advanced can be harmonised with experimental observations.

Three short notes are added by the translator dealing respectively with (1) the direct measurement of osmotic pressure by Fouard's method; (2) the radioactive elements; and (3) the methods of measuring the number of molecules in the molecular volume.

Text-book of Mechanics. By Prof. L. A. Martin, jun. Vol. iii., "Mechanics of Materials." Pp. xiii+229. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 1.50 dollars net.

The present volume forms the third of a series, the first dealing with statics and the second with kinematics and kinetics, having been reviewed in NATURE of May 16, 1907, and February 6, 1908, respectively. The author has not attempted to treat the mechanics of materials exhaustively; the matter includes simple stresses and strains; the strength and elasticity of beams; statically indeterminate beams; struts and columns; torsion; general theorems of stress and strain; compound stresses; the principle of work as used in computing deflections.

The calculus has been used freely, and the impression is given to the reader that there has been a straining after mathematical effect, instead of the mathematics employed being made subordinate to the clear expounding of the mechanical principles involved. Illustrations have been taken, not because of their practical importance, or of their service in elucidating the subject, but because "they furnish interesting applications of the calculus." We note the very scanty use made of the ellipse of stress, although by means of this method much shorter and more readily comprehended solutions may be obtained in many cases. The same straining after mathematical effect may be observed in the treatment of thin cylindrical and spherical shells under internal pressure. Methods of testing and experimental results are almost absent, an omission which helps to contribute to the air of unreality in the treatment.

Some minor blemishes occur; in finding and using a formula for the horse-power transmitted by shafting, the reader is not warned that the torque must be uniform—a state of affairs which scarcely ever occurs. The "dangerous section" of a beam is defined as that at which maximum bending moment occurs; this will be the case in some instances, but a better and more general definition would be that section which has maximum stress. The book has clear diagrams, and numerous, well-considered exercises for working out are included, a point which will recommend the volume to many students.

The Photographic Annual, 1911–12, *Incorporating the Figures, Facts, and Formulae of Photography: a Guide to their Practical Use.* Edited by A. D. Godbold. Seventh edition. Fourth year of publication. Pp. 293. (London: G. Routledge and Sons, Ltd., and Dawbarn and Ward, Ltd.; New York: Tennant and Ward; Melbourne: Kodak Australasia, Ltd., 1911.) Price 1*s*. net.

In the compilation of this volume a new departure has been made embodying considerable alterations from previous issues. Thus, for example, the interesting glossary has this year been omitted, and the editor quite rightly thinks that by this means he avoids the undue repetition of matter, and that reference can easily be made to previous volumes by those who wish to look up such matters. The book opens with the usual series of articles on special topics, and in this issue they relate to the subjects of aërial, flower, and night photographs, together with picture-making by the bromoil and oil processes, and hints for home portraiture. All these contain very concise information for those who wish to take up the subject, and each is well illustrated by series of excellent plates. Mr. Griffith Brewer's fine photograph of St. Paul's Cathedral, taken from the balloon "Vivien," on May 22, 1909, is reproduced.

Following these articles is a series of coordinated data which is always valuable and ready to hand. Thus a list is given of classes for instruction in photography, bibliography, railway companies' lantern slides, federation lecturers, and lectures, &c., and the formulæ as recommended by the leading plate and paper manufacturers. Pp. 163 to 291 are devoted to the "Figures, Facts, and Formulæ," which always form the distinguishing feature of this annual; this section contains a mine of useful and up-to-date information, and should be available in every photographic studio. Those photographers who are not acquainted with this annual, and their number cannot now be many, should undoubtedly examine the book for themselves in order to form a better idea of the everyday information embodied in it.

Das Phytoplankton des Süsswassers mit besonderer Berücksichtigung des Vierwaldstättersees. By Prof. H. Bachmann. Pp. 213+xv plates. (Jena: Gustav Fischer, 1911.) Price 5 marks.

This volume is intended as a general summary of our present knowledge of fresh-water phytoplankton, with a passing reference to that which is found in the lake of Lucerne. The first portion of the book, which deals with the methods of collection, the apparatus used for this purpose, and the quantitative estimation of results, is exceedingly good. The remaining five-sixths of the work (about 170 pages) is devoted to a biological and systematic account of the constituents of the phytoplankton, and the treatment of the Flagellata, Peridinieæ, and Myxophyceæ, which is largely based upon the recent work of Lemmermann, is also very good. The account of *Ceratium hirundinella* deserves special comment, as it is perhaps the most complete that has so far been written.

The diatoms are dealt with in a comprehensive way, more especially the plankton-species of the genus Cyclotella, but there is a strange omission of the genus Surirella, species of which are constant plankton-units in the lakes of the British area and in the large lakes of Central Africa.

There is a brief mention of the Desmidiaceæ as plankton-constituents, but the author's synopsis of the genera is not quite accurate in detail. A fuller treatment of this group should be given in any general work dealing with fresh-water plankton, as there are probably more species and varieties of desmids exclusively confined to the plankton than can be found in any other group of green algæ. Moreover, with the exception of a few species of Surirella (omitted in this work), the plankton-desmids are almost the only known constituents which give the fresh-water plankton a definite geographical character, and thus save it from a monotonous cosmopolitanism.

In contrast to the brief treatment of the Desmidiaceæ, there is a somewhat extended treatment of many of the Protococcales, a considerable proportion of which are only casual plankton-constituents.

The text-figures are quite good, but the plates are not of a very high standard. The diatom plates are the best, but the desmids, so poorly figured on plate v., are, with three exceptions, not those usually observed even in the plankton-community of the lakes of western Europe. G. S. West.

Peeps at the Heavens. By the Rev. J. Baikie. Pp. 96. (London: A. and C. Black, 1911.) Price 1*s*. 6*d*. net.

Mr. Baikie's "Peeps" will, we have no doubt, lead many young people to long for, and to ensure getting, more than peeps into the wonderful phenomena he describes so interestingly.

The order in which the sun, the moon, the planets, and the extra-solar bodies are described is the usual one, but Mr. Baikie has introduced an originality and an attractiveness into the descriptions which are bound to appeal to all those who are children in these matters. In one or two places this has perhaps led to slightly inaccurate word-pictures. For example, on p. 58, he says, "I do not think that there is a more lovely picture to be seen in all the heavens than Saturn, with his three rings and his ten moons"; any beginner who looks at Saturn expecting to see *ten* moons will probably be considerably disappointed.

The fourteen plates in the book add greatly to its value, as do the constellation figures printed on the inside covers, while the picture of the great comet of 1910 on the front cover adds to the book's attractiveness. Many of the plates are from original drawings by Miss Constance Baikie, who must be congratulated upon the manner in which she has used colour and form to make pictures certain to attract young readers. W. E. R.

Vergleichende Physiologie. By Prof. A. Pütter. Pp. viii+721. (Jena: Gustav Fischer, 1911.) Price 17 marks.

Prof. Pütter's book on "Comparative Physiology" is not of the same ambitious character as the one edited by Prof. Winterstein, which has recently been noticed in these columns. It is nevertheless an extremely useful book, and is packed full of information. It is to be thoroughly recommended as a trustworthy and up-to-date guide to those who are working at this branch of science. In tackling a subject of this nature, there are obviously two methods of dealing with it. One method is to take the various groups of the animal kingdom, and describe the functions of each; the other is to take physiological functions as the main headings and deal with the variations in each met with in the different zoological phyla. To the physiologist it is obvious that the latter method is the best, and it is the one Prof. Pütter has adopted. The chapters are therefore headed protoplasm, metabolism, nutrition, nervous activity, and so forth.

We cannot help remarking how overwhelmingly important the applications of chemistry to biological problems is becoming. Organic chemistry and physical chemistry are helping physiologists to elucidate the phenomena of life in an ever-increasing manner. The greater part of the present volume is occupied in dealing with these questions.

W. D. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Thames Valley.

In the "Physical Geology and Geography of Great Britain," Sir A. Ramsay expressed some interesting speculation about the relation formerly existing between the valleys of the Thames and the Severn. According to his view, the Severn Valley was the older, being "one of the oldest in the lowlands of England." He considered that the secondary strata to the south-east of that river originally drained into it, and that subsequent subsidence altered their inclination to an eastward slope, causing the waters to cut a new channel through the Oolites and Chalk towards the east, the direction in which the Thames flows at present. This view, I believe, has never been favourably entertained by other geologists, owing to the absence of corroborative evidence of such a change in the dip of the beds as Ramsay postulated.

Nevertheless, I venture to ask consideration for a feature in the fauna of the Thames Valley which is difficult to reconcile with the belief that the Thames always flowed eastward. I have called it a feature; I should have said, more correctly, the absence of a faunal feature characteristic of other eastward-flowing rivers in England.

In all the rivers between the Yorkshire Ouse and the Norfolk Ouse is found that remarkable fish the burbot, or eel-pout (*Lota vulgaris*), a creature remarkable not only as being the only member of the Gadidæ, or cod family, known to inhabit fresh water (the North American *L. maculosa* can be regarded only as a geographical variant of the species), but also on account of its severely restricted distribution in Great Britain. It seems fairly safe to attribute the presence of this fish in the district indicated to the former connection of these rivers—the Trent, the Nen, the two rivers Ouse, &c.—with the great Rhine system at a time when the North Sea was a vast plain, through which these streams found their way to join the mighty river on its course to the Arctic Ocean. The burbot, I believe, abounds in the Rhine at this day; if, as is commonly assumed, the Thames was ever a tributary of the Rhine, why does it contain no burbot?

On the strength of a passage in Leonard Mascall's "Booke of Fishing with Hooke and Line" (1590), I, in common with many others, was led to believe that the burbot did once inhabit the Thames; but I think I can now prove that we have been misled by a printer's or writer's error.

"There is a kind of fish in Holand [not the kingdom of Holland, but the south-eastern district of Lincolnshire] in the fennes beside Peterborrow, which they call a poult; they be like in making and greatness to a whiting, but of the cullour of the loch [loach]; they come forth of the fenne brookes into the rivers there about, as in Wandsworth river there are many of them. . . . They are taken in welles [eel-baskets] and at waters [weirs] likewise. They are a pleasant meate, and some do thinke they would be as well in other rivers and running waters, as Huntingdon, Ware and such like, if those waters were replenished as they may be with small charge. They have such a plentie in the fenne brookes, they feed their hogges with them. If other rivers were stored with them, it would be good for the commonwealth, as the Carpe which came of late yeares into England. Thus much for the fenne poult."

Now it was easy to suppose that when Mascall wrote of the "Wandsworth river" he meant the Wandle, which joins the Thames at Wandsworth. But if the passage above quoted be read carefully it appears clear that he was treating only of rivers in the fen district, and that he referred, not to Wandsworth on the Thames, but Wansford on the Nen, a few miles west of Peterborough. This explains the difficulty of understanding how a vigorous and prolific fish, once inhabiting the waters of the Thames Valley, and not depending, like the salmon, upon free access to the sea, could have totally disappeared within 300 years. The burbot never inhabited the Thames system, a fact which seems to support Sir A. Ramsay's doctrine that the Thames formed originally part of the Severn system, with a general flow from east to west, while the basins of the Trent and Yorkshire Ouse were connected with the Rhine system. HERBERT MAXWELL.

Monreith, Wigtownshire, December 20.

The Inheritance of Mental Characters.

SIR H. BRYAN DONKIN (December 14, p. 210) thinks that I am quibbling, and Dr. Reid (*ibid.*) thinks that I am not clear as to the situation. I cannot argue these points. Suffice it to say that my clearly defined object was and is to show, not that Prof. Pearson's statement quoted by Dr. Reid was right, but that Dr. Reid's condemnation of it was wrong and misleading.

A real difficulty appears to me to lie in the fact that different people use different names for the same thing, and the same name for different things. No so-called character is more than a potentiality in the fertilised ovum. The result of the action of the environment is to produce successive stages in the development of these potentialities. The potentialities, which are subject to variations and may be inherited, are, to me, the only true inborn characters. I gather from Dr. Reid's writings that this is substantially his view.

All the characters quoted from Prof. Pearson are mixtures of acquired and inborn elements. If the fore-arm were never used from birth, it would develop no more than it does in a case of infantile paralysis. If any two children were given precisely the same amount of exercise and of other factors in the environment which influence the development of the potentiality, the development in each would be different. The histories of those remarkable families, the Jukes and Zeros, which produced an enormous number of criminals in a few generations, are well known. Some of the criminal members did not have the same educational environment as their parents. The character dealt with in the fore-arm measurements does not include the presence or absence of the limb. It is development dependent upon a potentiality and a similar, but not identical, environment. Conscientiousness, as dealt with by Prof. Pearson, is development dependent upon the same factors. If it is contended that variations in the environment influence the character, I agree, but in the sense implied here both characters are certainly inherited in the same way.

Dr. Reid again quotes Prof. Pearson, this time as saying that the characters with which he dealt were "bred, not created." I accept Dr. Reid's statement that the meaning implied by "bred" is equivalent to inborn, and by "created" acquired. Having made this quotation, Dr. Reid asks: "Is potentiality meant here?" When I read Prof. Pearson's Huxley lecture I certainly thought that it was. "Geniality and probity and ability may be fostered, indeed . . . but . . . their origin is deeper down than these things. They are bred, not created." Not only this passage, but others, led me to believe that Prof. Pearson, in saying that these characters are inherited, implied that their origins, as distinct from acquirements, are inherited.

Leaving speculations as to Prof. Pearson's private thoughts, and as to how he intended his public statements to be interpreted, may I pursue a more profitable course in asking Dr. Reid for enlightenment as to what *he* means? Dr. Reid's last letter gives me the impression—I am very likely mistaken—that he considers educability, as regards mental characters in man at any rate, as a single potentiality for development, and that the kind of stimulus or stimuli determines which, and to what extent, characters will develop. Now, though I agree with Dr. Reid that individual characters are less certainly inherited than racial, I hold, and I think that he does so too, that the former are the material from which natural selection produces the latter. Unless each of the mental characters is dependent upon a separate potentiality, we must conclude that a change took place whereby all the mental potentialities were massed together; for it is inconceivable that the various adaptive instincts in the lower animals could have evolved otherwise than separately. We are by no means confined to pure instincts or to the lower animals. It would doubtless be possible to teach a bulldog to point, but it is certainly more difficult to teach bulldogs generally to point than it is to teach pointers to point. It is also usually more easy to bring a pointer of good ancestry to a high state of efficiency with regard to his various and

particular mental characters than one of bad ancestry, and a very high state of efficiency is common only in dogs well bred from the Field Trials point of view. These particular mental potentialities are just as much inborn characters as the shape of the dog's head; they are modified by selection in precisely the same way, and are transmitted, with variations, from parents to offspring.

If the existence of heritable variations in each particular mental potentiality be accepted, the conclusion is practically unavoidable that, as Prof. Pearson has suggested, the majority of the lowest class of the population is inferior in capacity for intellectual development to the majority of the middle and upper classes. Favourable variations which are inherited must generally result in a rise, unfavourable in a fall in social position, and a fall to the lowest class means a high mortality among the offspring. Moreover, the upper and middle classes are subjected to continual selection. A known period of selection has changed the Jews from an extraordinarily militant, quarrelsome, and bloodthirsty race to an undoubtedly peaceful, and probably the most generally intellectual race in the world. Any individual amongst them who continued to react to violence by developing a violent temperament must certainly have been eliminated, while survival depended upon a high capacity for making other mental acquirements. The comparative brevity of the period during which selection lasted suggests that mental potentialities respond, if anything, more quickly to selection than do physical potentialities.

Glasgow, December 16. CHARLES WALKER.

Theory of Complex Cartesian Coordinates.

A RECENT number of the Proceedings of the London Mathematical Society (vol. x., part iii.) contains a note of mine on a theory of complex Cartesian coordinates, in which the complex point $(a+di,\ b+ei,\ c+fi)$ is represented by the segment AB joining the real point $(a,\ b,\ c)$ to the real point $(a+d,\ b+e,\ c+f)$. Since its publication I have learnt that the same theory has been discussed by Mr. Ellery W. Davis in the Nebraska University Studies (Lincoln, 1910).

I am writing now for two purposes. In the first place, I wish to express my regret that, not knowing of Mr. Davis's work, I made no reference to it in my paper. Secondly, the fact that two investigators have quite independently, and both after a study of v. Staudt, invented *the same* representation of complex points, affords a presumption that it is a natural one. Personally, I believe that many interesting facts will follow from further investigations in this field: it will never replace Staudt's projective theory, which is absolutely perfect so far as it goes, but it may help to make the comprehension of Staudt's work a little easier, and thus popularise one of the most splendid works of mathematical genius.

I may add that parts of Mr. Davis's paper were read before the American Mathematical Society (April and November, 1907; November, 1909) and the British Association (August, 1909). I gave a brief account of the theory myself to the Mathematical Association at a previous date; but really there is no question of priority in dispute. Probably Mr. Davis, like myself, has been in possession of the elements of the theory for a long time. G. B. MATHEWS.

10 Menai View, Bangor, December 19.

Science and Literary Form.

THE gap between the terminology of commercial science and the ordinary amenities of language seems to be hopelessly widening. The following specimens are culled at random from the account of the exhibition of the Physical Society, contained in *The Times* Engineering Supplement of December 20:—"synchroscope," "decremeter," "lumeter." The word "speedometer" is now consecrated by text-books and even by legislation. All this gives one pause to think, when it is remembered how careful the early scientific pioneers in electrical developments (Kelvin, Maxwell, &c.) were to select suitable terms. The question even persists in obtruding itself, in what relation all this stands to the view that education can be based on a purely scientific training. J. L.

Cambridge, December 20.

The Weather of 1911.

THE interesting question of Sir Edward Fry in NATURE of November 16 can be defined more precisely by the other question: Where did unusual precipitation occur in the European summer, 1911? I replied to this question, asked by the editor of *Ciel et Terre*, by pointing to the excessive rains of middle and northern China, Japan, and the Philippine Islands in the same summer, 1911. Indeed, the rains of Baguio (Luzon), July 14–17, established a record only comparable with the rains of Cherrapunji, June 12–16, 1874. Baguio received in four days 2239 mm.; Cherrapunji in five days 2598 mm. More comparisons may be found in the *Frankfurter Zeitung*, December 8, ii., and, I hope, at an early date in *Ciel et Terre*. Here I emphasise the connection of these rains, especially in Hondo and Luzon, with typhoons, proved clearly for the latter island in the preliminary communication of P. José Coronas, assistant director of the Manila Observatory: "Three typhoons, which caused heavy floods in Luzon."

In NATURE of April 11, 1907, p. 560, I published a paper, "Atmospheric Seesaw-phenomena and the Occurrence of Typhoon Storms." I applied afterwards the law there stated to the weather of the summer of 1907, being on the Atlantic side of the earth extremely cool, in a paper, "Klimaschwankungen und der thermisch-barometrische Ausgleich," in the *Meteorologische Zeitschrift*, 1909, vii., pp. 331–2. Indeed, the formation of tropical cyclones (typhoons) in that summer largely preponderated in the great Pacifical focus of such storms. The same explanation as for the cool summer of 1907 can, strange to say, be employed for the dry and hot summer of 1911. A difference is only caused by the larger development of the Azores-maximum of aërial pressure in 1911. This development made the Pacifical depressions arriving on the western side of Canada travel more northerly than usual, and therefore arrive in Europe on the more easterly coasts of Russia instead of, as in 1907, on the coasts of western and central Europe. To this also may be ascribed the occasional excesses to night frost in central Europe during June and August, 1911, July descending also to +2° C.

The development of the maximum was caused by a somewhat independent and contrary northerly precession of subtropical conditions over Europe and of tropical conditions over subtropical latitudes. These caused another strange phenomenon of aërial pressure in Europe and also in North America, namely, a retrograde motion of depressions similar to the first part of tracks of tropical cyclones, the phenomenon of "Zugstrasse VI.," as I designated it. I found this extremely rare phenomenon over Europe in May, June, and September, 1910, October and November, 1911, and over North America three times in August, 1911. Its occurrence in Europe coincided with well-developed "Hochwasses Tiefs." Conducting them quickly westwards, and preventing them from pouring out plainly their precipitations, it contributed to the relative dryness of October and November, 1911. WILHELM KREBS.

Grossflottbek (Holstein), December 9.

Nature of Light emitted by Fireflies.

IN NATURE of November 23 (vol. lxxxviii., p. 111) there is a letter from Messrs. Singh and Maulik on the nature of the light of the firefly (Luciola), in which they report the penetration of opaque substances by the rays from these insects to such an extent as to affect a photographic plate. Their results are essentially similar to those reported by Muraoka (*Wiedemann's Ann. d. Chem. u. Physik*, 1896, vol. ccxcv., pp. 773–81; Journ. Coll. Sci., Tokyo, 1897, vol. ix., pp. 129–39), an explanation of which has been given by Molisch ("Leuchtende Pflanzen," Jena, 1904; Report, Smithsonian Institution, Washington, D.C., 1905, pp. 351–62). The spectral structure of the light of Lampyridæ has been studied spectrophotographically by Ives and Coblentz (Bulletin of the Bureau of Standards, Washington, D.C., 1910, vol. vi., pp. 321–36), and also separately by Ives (*Physical Review*, 1910, vol. xxxi., pp. 637–51) and Coblentz (*Physikal. Zeitschrift*, 1911, vol. xii., pp. 917–20; also in *Canad. Entomol.*, 1911, vol. xliii., pp. 355–60).

Before attempting further work along this line Messrs. Singh and Maulik would do well to read the above papers, and to refer to Mangold's monograph "Die Produktion von Licht" (second half, vol. iii., Winterstein's "Handbuch der vergleichende Physiologie," Jena, 1910).

F. ALEX. MCDERMOTT.

Industrial Research Laboratory, Pittsburg, Pa., U.S.A., December 11.

WHAT SHORE-WHALING IS DOING FOR SCIENCE.

THERE is no group of mammals about which, in recent years, our knowledge has increased with greater rapidity than in the case of the whales. Although for centuries whales have held an important place in the commercial history of the world, until a short time ago almost the only data relating to their habits were drawn from the stories of the men who had hunted them. At best the pursuit incurred great danger and hardship, and the cruises occupied several years. It was, therefore, almost an impossibility for a naturalist to obtain first-hand knowledge of their habits.

But the dearth of accurate information extended not only to their habits, but to their physical characters. Until about twenty-five years ago, there were few naturalists who had an opportunity of seeing, in the flesh, more than a half-dozen or so whales during their entire life. These were usually carcases which had been cast upon the beach. Almost invariably these stray examples had been dead for days before they were washed ashore, or came under the notice of a trained scientific observer, and had lost much of their original proportions and colour. A whale's body begins to generate gases at an astounding rate as soon as the animal is dead, and within a very few hours is so swollen and distorted that the true proportions are almost lost. Even naturalists did not always take this fact into consideration and their descriptions and figures are notable chiefly for their inaccuracy.

It is only within a very few years that the rapidity with which cetaceans change colour when killed has been generally recognised, and it is a most usual thing to find whales described in scientific papers as "black" which are never black in life. By far the greater number of whales and dolphins have various shades of slate or grey on the upper-parts, and if exposed to the sun for a few hours these portions turn jet-black. Again, there is, in all cetaceans, great variation in colour and form among individuals of the same species, and whales from the same school or "pod," may differ widely in proportions and general colour. Some may be long and slender, others short and thick: one may have a light grey back and pure white under-parts, while a second, taken from the same herd, is dark slate above and strongly shaded below. Quite naturally when these extremes came under the notice of a man of science, who had, perhaps, seen but three or four whales in his entire life, they were at once judged to be representatives of different species and given new names. This course can scarcely be condemned, for, under existing conditions, it was almost the only one to be followed; but, although it did put on record many valuable facts concerning the history of the animals, it also resulted in multiplying names to such an extent that the work of later investigators in separating the valid from the invalid species has become a herculean task; quite false conclusions were also drawn as to the distribution of the various whales which only a vast amount of labour and study can rectify.

For many years almost all the information concerning the large cetaceans centred about three species, viz., the sperm, the "bowhead," or Greenland right whale, and its smaller relative, the North Atlantic right whale, or "Nordkapper." Other species, of less commercial value, received but comparatively little attention.

In the year 1864, however, Swend Foyn, a Norwegian, invented the harpoon-gun, which was mounted on the bow of a small steamer and fired an iron harpoon having an explosive head, or point, called the "bomb."

With the further development of the harpoon-gun, a new and great industry grew up, for it made possible the capture of whales known as "rorquals" or "finners" in sufficient number to warrant the erection of stations at certain points on the shore, near the feeding-grounds of these animals, where they could be brought in, and the huge carcases converted into commercial products. Instead of saving only the oil and baleen (the "whalebone" of commerce) as was the case with the sperm and bowhead whales, which were usually killed far out at sea, it was possible also to utilise the flesh, bones, blood, &c. Previously these whales had been little troubled by the men who hunted in a small boat, and with a hand-harpoon and lance, for the great speed of the animals in the water and their tendency to sink when killed caused them to be let alone by the early whalers; moreover, their blubber was so thin and the baleen so short and coarse, that, if these parts alone were utilised, the animals were not worth the trouble of killing.

FIG. 1.—Drawing out a Finner Whale. Japan.

In a very few years after the harpoon-gun was

perfected, stations had sprung up on the coasts of Norway in every available place, and later were established on the American shores of the Atlantic. Newfoundland was the first extensive hunting-ground for American whalers,[1] and only a few years ago as many as eighteen stations were in operation upon that island and in the immediate vicinity.

FIG. 2.—Drawing a Blue Whale upon the slip. Japan.

The great success of the Norwegian methods attracted so much attention that stations were erected in every part of the world where conditions were favourable—in British Columbia, south-eastern Alaska, Bermuda, South America, and the islands of the Antarctic; on the coasts of Japan, Korea, Africa, and Russia. Australia is soon to be invaded, and only a few months ago a company announced its plans for carrying on operations on a large scale in the Aleutian Islands. In New Zealand, humpback whales are being taken in wire nets, and so in nearly every part of the globe the pursuit goes on.

The number of whales taken during a season varies greatly with the locality, but at one of the Vancouver Island stations, when I was there in 1908, 325 were killed in seven months. In a single week twenty-six whales were captured, and on June 30 the ss. *St. Lawrence*, Captain Larsen, brought in four humpbacks, one blue whale, and one finner. Thus it is obvious that a naturalist who is fortunate enough to remain for some time at one of these shore-stations has before him wonderful opportunities.

Whales are such enormous creatures that the ordinary methods used in the study of other animals cannot be applied to them. Instead of having actual specimens before him for comparison, a naturalist must depend almost entirely upon photographs, notes, measurements, and descriptions. Until shore-whaling began such data were rare and most unsatisfactory. When a whale is "cut in" as it lies alongside a ship it is never possible to see the entire animal at once; it is almost impossible to secure photographs of real value for comparative work; even measurements can be taken only with difficulty, and not without a large percentage of error. Anatomical investigations are out of the question, because, as soon as the blubber has been stripped off, the carcase is turned adrift.

By the establishment of shore-stations these difficulties have been eliminated. The whales are usually drawn entirely out of the water upon a long inclined platform—called the "slip"—where, before the blubber is stripped off, they can be measured, photographed,

FIG. 3.—"Cutting in" a Right Whale.

[1] About the year 1875 a shore-station was established at Cape Cod, Mass.

and described. As they are being "cut in" it is possible to make a fairly detailed study of the fresh skeleton and other parts of the anatomy—if the investigator is not afraid of blood and grease.

Moreover, the great number of whales of a single species which are taken facilitates in an unequalled way the study of individual variation in colour and proportions, which evidently is greater among some of the large cetaceans than in any other group of mammals.

The opportunities for the observation and collection of specimens given at the shore-stations, which are located in widely separated parts of the world, has made it possible to investigate the theory, advanced some years ago, that most of the species of large whales are cosmopolitan in distribution; that is, that the humpbacks found in the Atlantic differ in no essential respects from those of the Pacific, and that all belong to a single widespread species.

FIG. 4.—A Female Sperm Whale.

Dr. F. W. True, assistant secretary of the Smithsonian Institution, published in 1904 a great work entitled "The Whalebone Whales of the Western North Atlantic," in which he discussed the relationship of the Atlantic whales; this book was made possible in its present complete form only by study at the Newfoundland shore-stations. Other shorter papers, too numerous to mention, which have greatly increased our knowledge of these interesting animals, have appeared within the last ten or fifteen years, many of them illustrated with photographs of the whales described.

The Norwegian method of capture has also made possible, and, in fact, comparatively easy, a study of the habits of the large whales.

The ships which hunt from these shore-stations are trim little vessels, about 90 or 100 feet in length, and although they can scarcely be called comfortable, they furnish a not uninviting home for a short stay, if one is a good sailor. From the deck the movements of the whales can be easily seen and studied, and many opportunities are given to secure photographs of living animals. Often such pictures show many things that would otherwise have been unnoticed.

The directors of the shore-whaling companies and the managers of the stations have always been very willing to assist in the study of the animals which form the basis of their industry, and have generously allowed the use of their ships and stations. Not only this, but they have in many instances gone to considerable trouble to secure specimens that could be prepared and presented to museums for the purpose of exhibition and osteological study. Thus the old saying that "It is an ill wind that blows good to no one" applies very decidedly to the whaling industry. It is, however, deeply to be regretted that the wholesale slaughter of whales will inevitably result in their early commercial extinction; but meanwhile science is profiting by the opportunities given for the study of these strange and interesting animals.

ROY C. ANDREWS.

THE IMPROVEMENT OF INDIAN WHEAT.[1]

THE idea prevails that Indian wheats are weak and do not behave well in milling; their chief points of excellence are their great dryness and, owing to the thinness of the bran, the large proportion of flour obtained from them when milled. Mainly as the result of trials, carried out by Messrs. MacDougal in 1882, the cultivation of weak, soft white wheats for the purpose of export has been consistently advocated in India. Inquiry amongst the natives has shown, however, that a stronger type of wheat is preferred for their own use.

During the past few years the scientific selection and cultivation of these native strong wheats has been carried out at the Agricultural Research Institute, Pusa, on lines similar to the experiments of Prof. Biffen at Cambridge. The results have established beyond doubt that strong, free-milling wheats, but little inferior to Manitoba wheats, can be grown at Pusa. The selected varieties have been submitted to Mr. A. E. Humphries during each of the last three years, and his report, which is included in the bulletin, indicates that they possess great potentialities as regards baking value. They are particularly adapted for special treatment with malt extract and yeast foods, behaving in this respect as Manitoban good-grade wheats produced in a dry season.

From the cultivator's point of view the yield of a variety of wheat is of more importance than the quality of its grain. Much attention has been paid to this point at Pusa, and it has been established that the limiting factors affecting yield in India are the length of the growth period, the water supply, and, particularly in dry districts, the strength of the straw.

[1] "The Milling and Baking Qualities of Indian Wheat." By Albert Howard and Gabrielle L. C. Howard. Bulletin No. 22. Agricultural Research Institute, Pusa. Price 8d.

It was at one time considered impossible to combine high quality and high yield, but it has been shown now, both at Cambridge and at Pusa, that this is not the case. Half a dozen wheats have been bred at Pusa which give high yields of both grain and straw.

The problem of producing strong wheats in India suitable both for consumption in the country and for export to England, and at the same time profitable to the growers, is considered solved. Two shortcomings of the Indian wheats still await improvement. These are want of standing power of the straw and want of rust-resisting power.

At the same time, the producing power of the soil at Pusa has been doubled by hot-weather cultivation (see Nature, February 17, 1910), by moisture conservation, and by embanking with occasional green manuring. In this way a yield of 40 bushels to the acre has been produced without irrigation or manure.

It remains to be proved that the selected wheats will do equally well in the farmers' hands in other parts of India, and that the methods adopted at Pusa can be applied elsewhere. E. F. A.

MY TROPIC ISLE.[1]

THIS book, which is beautifully illustrated by appropriate photographs, as well as admirably written, is quite above the normal type of its class. It is sufficiently romantic and suggestive of De Foe to avoid very clear geographical indications or maps to show the position of "My Tropic Isle," and one is left to infer that it is an island or islet not far from the coast of northern Queensland, and well within the area of tropical Australia. It was "an unpolluted isle, without history, without any sort of fame . . . the most fascinating, the most desirable on the coast of North Queensland," when permanent settlement began on September 28, 1897.

The author landed on this tropic isle weighing a little more than eight stone, and in a frail physical state, yet "trees had to be felled and sawn into proper lengths for piles. . . . With blistered and bleeding hands, aching muscles, and stiff joints he persevered." Whilst the house was being built they lived in tents—the "they" standing apparently vaguely, first for the author and a few friends, then, it may be conjectured, for a wife and children. Meanwhile, the Australian blacks they had brought with them obtained fish from the sea coast and killed scrub fowl and pigeons. Gaps in the provender were filled up with tinned meat and bread and jam. Later a small area of forest land and a patch of jungle were cleared for the cultivation of maize, sweet potatoes, and vegetables. Fruit-trees were planted, and have since "been in the ascendant to the detriment of other branches of cultural enterprise."

The gradual emergence of a fairly civilised and comfortable house, of a regularly supplied larder from the wild gifts of nature, from farm and plantation, is quite as fascinating as the opening chapters of "Robinson Crusoe." Then we are made acquainted with the other inhabitants of the isle, insects, such as large wasps, which build terra-cotta warehouses in which to store the semi-animate carcases of grubs; the solitary bees that turn by degrees favourite volumes into a solid block of waxen comb. These and many other insects and spiders are attacked by more or less fantastic lizards, and by bats, "sharp-toothed and with pin-point eyes, swooping in at one door and

Fig. 1.—Umbrella Tree (*Brassaia actinophylla*). From "My Tropic Isle."

[1] "My Tropic Isle." By E. J. Banfield. Pp. 315. (London T. Fisher Unwin, 1911.) Price 10s. 6d. net.

departing at the other, having rapidly garnered their prey from the rafters."

The chapter on "A Plain Man's Philosophy" almost recalls to one the musings of Prospero on a somewhat similar isle; that on "Silences" is worthy of R. L. Stevenson; "His Majesty the Sun" brings home to one the peculiar quality of the climate of northern Australia, which makes that region a country suited to the rearing of a white race, and therefore wholly different from the economic conditions of tropical Asia and Africa.

FIG. 2.—Egg Capsules of Bailer Shell. From "My Tropic Isle."

We are told much about sea-worms and sea-cucumbers, marvellous fish, so marvellous, in fact, that if there were not photographic reproductions done from the life to support the descriptions we might think the latter overdrawn. Delightfully described are the interdependent relations between the giant anemone and the painted fish (Amphiprion).

"The good fellowship between the dainty fish—resplendent in carmine, with a broad collar, and waistband of silvery lavender (or rather silver shot with lavender) and outlined with purple—and the great anemone is apparent. If the finger is presented to any part of the latter, it becomes adherent; or if the anemone is not in the mood for food, it curls and shrinks away with a repulsive demeanour. But the beautiful fish on the least alarm retires within the many folds of its host, entirely disappearing, presently to peep out again shyly at the intruder. It is almost as elusive as a sunbeam, and most difficult to catch, for if the anemone is disturbed it contracts its folds and shrinks away, offering inviolable sanctuary. If the fish be dissociated from its host, it soon dies. It cannot live apart, though the anemone, as far as can be judged from outward appearances, endures the separation without a pang.

"However, it is safe to assert that the association between the stolid anemone and the painted fish—only an inch and a half long—is for their mutual welfare, the fish attracting microscopic food to its host. And why should one anemone greedily seize a fish and another find pleasure in the companionship of one of the most beautiful and delicate of the tribe?"

The account of the development of the Bailer shell (Melo or Cymbium) from "a few drops of translucent jelly—as free from earthly leaven as a dewdrop" to a very large and capacious bowl-shaped shell, emitting egg-clusters sixteen inches long and twelve inches in circumference is most interestingly told. Other chapters of biological value and great literary charm are entitled "Some Curious Bivalves," "Barrier Reef Crabs," "Insect Ways," "Swifts and Eagles," "Socialistic Birds"; besides those which describe Hamed, the pearl-fishing Arab of Jeddah, and the black Australians with their superstitions, their quaint ways and dialect, their fine physical development and naïve charm of manner.

MALARIA IN INDIA.

IT is usual to preach nowadays that plain speaking does more harm than good; but I have reason to believe that some very plain statements which have appeared in NATURE and elsewhere on the subject of Indian medical research and sanitation have had a converse effect. It is now a great pleaure to learn from the third number of the quarterly publication of the Government of India, called *Paludism,* that that Government has set aside the sum of 500,000 rupees (about 33,000*l.*) for an Indian Research Fund to study medical and sanitary problems. No other Government possesses such a magnificent opportunity to add to the common stock of knowledge on such subjects. It rules an immense population; it draws a great revenue; and it is served by hundreds of well-trained medical officers. We are not yet informed as to the details of the allotment, but funds are the sinews of science as of war, and the Indian Government will certainly never regret the step it has taken.

For a number of years past increasingly good scien-

tific medical work has been done in India, and the number of *Paludism* referred to adds to it. Major W. H. Kenrick, special malaria officer, Central Provinces, studies the effect of malaria on birth-rates and death-rates—a difficult subject, which has been considerably neglected, though it lies at the basis of prevention. He compares thirty-four healthy villages possessing a spleen-rate of only 4 per cent. and a total population of 19,064, with thirty-three "hyperendemic" villages with a spleen-rate of 80 per cent. and a total population of 10,825. The *birth-rate* in Britain is, I understand, not much affected by season; but in healthy Indian villages it seems, curiously enough, to be highest in October and November, which the author attributes to increased frequency of conception after the gathering of harvest in the first months of the year. In malarious areas, however, these are also the most feverish months, owing to the accumulated effect of the untreated autumn infections, and the result is that the most favourable conception period is delayed until June–July and the corresponding maximum birth-rate until March–May. Yet the *total* birth-rate is not much influenced, even by severe *endemic* malaria, though it is much reduced by *epidemic*, that is, exceptional malaria.

The reason for this probably lies in a consideration discussed in section 31 of my book on the prevention of malaria. In regions of high static (*i.e.* constant) malaria-frequency, nearly all the children are rendered comparatively immune at puberty, so that there should be comparatively little sickness among the *adults*—enough only, perhaps, to delay conception among the women without stopping it entirely. But in epidemic times the frequency of reinfections is sure to be so enormous (see below) that the comparative immunity will be overcome, and the sickness will suffice to reduce as well as to retard the birth-rate.

It would be interesting to ascertain by such good studies as those of Major Kenrick how far malaria checks delivery as well as conception. Regarding the *death-rate*, he finds that during the three years 1908, 1909, 1910, they were respectively 24, 22, 23, in the thirty-four healthy villages, and 38, 32, 44 in the thirty-three hyperendemic ones (plague and cholera being absent in all), and concludes that malaria-frequency of over 80 per cent. spleen-rate measure causes an increase of from 10 to 15 per mille of total death-rate. Nothing shows better the enormous anti-human effect (as it may be called) of malaria in the tropics; the single disease, benign as it is, may cause a death-rate nearly equal to the whole death-rate of London due to all causes together.

Colonel J. R. Adie, special malaria officer, Punjab, found Plasmodia in 38 out of 150 British soldiers at Delhi Fort in November, 1910, and in 29 out of 71 children there. Yet all these were undergoing "prophylactic quinine treatment" at the time. This confirms what Malcolm Watson and others have observed elsewhere. In fact, I am beginning to believe that quinine is of little use in regions of very high malaria-frequency, for reasons to be given presently. It is surprising that the military authorities have not tried a more radical preventive measure at Delhi Fort long before this, in preference to allowing such an expensive article as a British soldier to be rotted by malaria in this manner. Colonel Adie also gives a good example of the errors of inadequate sampling. The 150 soldiers were examined in five successive batches of thirty each, and the percentages found infected were respectively 10, 36, 36, 20, 23, the mean being 25 per cent. Yet important conclusions, quite disregarding such error, have been previously based in India on even smaller samples.

The simplest, though not quite exact, method of measuring malaria-frequency is by observing the frequency of enlarged spleen (spleen-rate). But as it is easy to estimate roughly at the same time the degree of the enlargement, I have advocated for several years the additional computation of the average size of spleen and average degree of enlargement found. Thus in Mauritius in 1907–8, in 30,137 children examined by a number of workers at my suggestion, we estimated that the average size of the spleen was 2·54 times the normal, the whole number of children affected being 34 per cent. of the total number examined. The table of details showed a strongly marked positive correlation between the average spleen and the spleen-rate, as exhibited in contiguous columns; but I thought that owing to several sources of error it would not be worth while to work out the relation further. This, however, has now been ably done by Major S. R. Christophers, with the aid of my figures and some of his own. He finds that the very interesting and simple linear relation $A=1+0{\cdot}05S$ holds where A is the average spleen estimated by my rules and S is the ordinary spleen-rate. This is certainly a much simpler function than was to be expected; but I will not discuss it at present, as a more detailed paper is promised.

I have no space to mention several other good papers and notes, largely entomological, in the number of *Paludism*. It is doubtful whether the entomologists will entirely accept the classifications of some of the Culicidæ suggested by James and Liston in the second edition of their book. The printing and appearance of the number leave much to be desired.

Years ago, in 1898, while infecting birds with Proteosoma by the bites of *Culex fatigans*, I made some observations which showed that such experiments might easily be utilised for studying questions of immunity and pathology in malaria. My work was interrupted and never resumed; but one of the most important sidelights was the following. Out of five sparrows which originally contained a very few Proteosoma, four showed a much more copious infection a week after being subjected to the bites of heavily infected mosquitoes. At the same time the infection of these birds was not so copious as in the case of most of the originally uninfected birds which I had previously dealt with (see my paper in the *Indian Medical Gazette*, vol. xxxiv., January, 1899). This obviously suggested (*a*) that fresh bites of infected mosquitoes will cause a severe recurrence even in subjects already infected; but that (*b*) this recurrent infection, though severe, will not be so severe as an original infection, probably owing to the previous establishment of partial immunity. I have often, fruitlessly, urged the continuation of this line of work. Major Christophers now reports ("Scientific Memoirs, Government of India," No. 46) two more similar experiments which, though they are not very convincing, tend to confirm the possibility of such reinfection. But he also gives eighteen experiments which strongly suggest that the severity of the infection in the birds depends largely on the number of, and degree of infection in, the mosquitoes—as already probable for theoretical reasons.

The importance of these points is rendered very manifest by my quantitative studies in epidemiology (see article in NATURE, vol. lxxxvii., p. 467, last paragraph but two), by which it is shown, for instance, that if 50 per cent. of the people are constantly affected under constant conditions, then about 63 per cent. of them will probably be infected or reinfected every four months. In such circumstances it will be extremely difficult to keep down the fever by quinine alone, a fact which explains the failures complained of in *Paludism*, pp. 7 and 34, and elsewhere. It must

therefore be combined with mosquito reduction when the malaria-frequency is high.

Dr. C. A. Bentley has published a very good report on malaria in Bombay and its prevention. He concludes that, as was manifest from the first, the principal measure must be the reduction of the carrier, *N. stephensi*. The cost should be about 100,000 rupees a year. Our studies of malaria are, then, advancing into fine detail; but I agree with Colonel King, C.I.E., that practical preventive measures should not be postponed until we actually become quite omniscient. That will imply a considerable loss of life in the meantime. We have already waited twelve years in India.

R. ROSS.

THE LONGEVITY OF ANIMALS.[1]

ONE of the most satisfactory results of the reorganisation of the Zoological Society of London is the series of papers dealing with important aspects of animal life which are now issuing from the pens of the society's officials. Instead of being content to amass, as formerly, a mere collection of as many strange beasts as possible for the inspection of the idle and curious, the officials are now directing their attention to many important points concerning the life of animals which could not have been examined, except where such unrivalled opportunities exist for their prosecution. Thus the Gardens bid fair to become a centre for important studies, while the health of the animals improves as the results are brought to bear on their treatment and housing.

In a recent paper Dr. Chalmers Mitchell has collected the available information supplied by records in the Gardens concerning the length of life and viability of mammals and birds.

On first glancing at this paper we are struck by the immense amount of information collected, and, on the other hand, by the small amount of knowledge which we really possess on so important a subject.

This deficiency is not likely to be easily eliminated, since our powers of ascertaining the actual length of life of any wild animal are, and must always remain, strictly limited. Sometimes an individual animal becomes abnormally marked, so that we observe and watch it for a period, or the unnatural life of a captive affords us material for estimating the longevity of the wild race; but such isolated observations can at the best only be regarded as approximate, and our knowledge of the longevity of the bulk of wild animals must always remain meagre.

Even our knowledge of the longevity of common domestic animals is far below the standard which might be expected. Domestic fowls are said by Dr. Mitchell to be capable of living for thirty years, yet, owing to commercial reasons, few members of the farmyard flock reach five years. It is the same with cattle. Although their potential longevity is, according to Dr. Mitchell, about thirty years, we habitually kill all our beef cattle and bulls under five, and a vast majority of our cows under twelve years. The same principle holds with all domestic breeds, the tendency being to speed up the processes of life to such an extent that the career of the organism is concluded at an artificially early date.

On the other hand, there are methods which may eventually yield a considerable increase of knowledge, and one of these is used by Dr. Mitchell, who has tabulated the numerous records kept in the prosectorium of the Zoological Society, and has calculated the average and maximum longevity of a large number of mammals and birds which have lived and died in the Gardens. From these it appears that the average duration of life of any species in the Gardens is as a rule remarkably below the maximum duration, so that, to the majority of animals, captivity, even under the care of experts and in spite of the resulting protection from enemies, is anything but conducive to great length of life. Even, however, after allowing for the undoubted shortening of life resulting from captivity, the potential longevity of mammals in general appears to be surprisingly low, and it may be some satisfaction to know that the possible duration of life in man is probably greater than that of any other mammal, excepting, possibly, the large whales.

In this respect birds seem to be fully equal, if not superior, to mammals, amongst which those who live longest are certain of the larger carnivora and ungulates. For instance, the potential longevity of lions is between thirty and forty years; a polar bear lived to thirty-three years in the Gardens, and the largest ungulates may reach fifty years.

Both whales and elephants are popularly supposed to be creatures of high potential longevity, but as regards the former, the officials of the Zoological Gardens are naturally not in a position to offer any information. As regards the latter, it appears that their reputation has been wrongly acquired, since for them Dr. Mitchell estimates one hundred years as being the probable limit, and twenty to thirty years a fair average duration. On the other hand, there are amongst birds several groups which equal or exceed such figures. A raven has been known to reach sixty-nine years, an eagle sixty-eight, while more than one parrot has been recorded to have survived to close upon or more than a century. It appears that some birds of prey may also reach 100, and that herons, swans, and geese have a high potential longevity. The ostrich, to judge by its size, ought to live as long as any other bird, but thirty-five years is considered to be an extreme age for it.

The most difficult mammals to keep in captivity are probably the insectivorous bats. For these the maximum duration of life in the Gardens has so far been only five months, but the failure to keep them alive is undoubtedly due, not to their being naturally short-lived animals, but to their great delicacy under artificial conditions.

These bats commence to breed at relatively so late a period of their life and produce so few young at a time or in any single season that the majority of them must in nature reach an age of at least five years, that is, if they are to keep up their numbers and without making any allowance for the undoubtedly high death-rate which is always prevalent amongst wild animals. Dr. Mitchell has calculated the death-rate for the London sparrows at at least 50 per cent. in a stationary population; in the mixed assemblance of vertebrates in the Zoological Gardens it has been observed to be 28 per cent., both of which figures are very much above that of human beings.

Weissman has sought to establish a correlation between longevity and reproduction, but Dr. Mitchell refuses to accept his interpretation. He believes, not that longevity has become adapted to reproduction, but that the rate of reproduction has been adapted to average specific longevity. In any case, the death-rate amongst prolific wild animals maintaining a stationary population must be stupendous; for instance, if a mouse produces only two litters a year of six young in each, then if all survive to maturity there will be fourteen mice where before there were only two, and if the population is to remain stationary

[1] "On Longevity and Relative Viability in Mammals and Birds: with a Note on the Theory of Longevity." By Dr. P. Chalmers Mitchell, F.R.S., Secretary to the Zoological Society of London. From the Proc. Zool. Soc. Lond., 1911. Published June, 1911.

twelve must die, and these figures may be regarded as probably below the mark where food is abundant.

The relative prolificacy of the rodents as compared with many of the carnivora which feed upon them does not come within the scope of Dr. Mitchell's paper, but it is a remarkable instance of the interrelation of the system of life upon our planet that those which are preyed upon should be on the whole more prolific than those which prey.

Possibly the shortest-lived mammals are to be found amongst the shrews, of which a solitary individual is tabled in Dr. Mitchell's records as having survived captivity for one month. Shrews are extremely difficut to keep alive under artificial conditions, and evidence has lately been produced to suggest that, in the case of the two commoner British species, the average duration of life is only about a year, but, since shrews are amongst the most prolific of mammals, this short period is more than sufficient for the maintenance of their numbers.

It appears that there is no rule which can be laid down in advance to govern the probable length of life of any given species. Size has very little to do with it, although in the same group the larger usually live longer than the smaller. The climate from which a bird or mammal comes has the smallest possible relation to its viability in captivity; in fact, not nearly so much influence as the nature of the cages, or enclosures, which the captive animal is to occupy, since Dr. Mitchell shows that a system of combining free access to open air with suitable dry shelters of small size offers the most ideal conditions for the health of captive animals. Strange to say, it is not animals from the tropics that suffer most from the London climate, but those from the Arctic, which seem to find a difficulty in altering the rhythm of their moults. Those from south temperate regions are even in a worse plight, since they have to face the fact that the conditions of winter and summer are reversed in the northern hemisphere.

A remarkable suggestion of Dr. Mitchell's is that animals from thickly populated countries are on the whole more difficult to keep alive in captivity than those from regions where men are less known. This applies especially to British birds, and Dr. Mitchell suggests that their lower viability in captivity in England, as compared with that of their immediate allies from any other part of the world, is probably due to their intolerance of man, without which unfortunately they would not have been able to maintain their existence as wild creatures.

NOTES.

THE meeting of the All-India Malaria Committee of the Government of India at Bombay in November last marks a revolution in Indian sanitation. For years past the a revolution in Indian sanitation. For years past the nothing but quinine prophylaxis against malaria, and have not encouraged, or have even discouraged, mosquito-reduction—alarmed, apparently, at what appeared at first sight to be the cost of the latter measure. Owing, however, to constant discussions (in which NATURE has taken a part), another spirit has now shown itself. The conference passed a series of resolutions in which mosquito-reduction is at last recommended for India—years after it has been regularly employed elsewhere. This ultimately means the formation of a genuine sanitary service for the whole of India on the lines recently suggested by Sir R. Ross, Colonel King, and Dr. Simpson in *The Times*, and with the enthusiastic medical services which the Government has at its command we may expect great results in time. The Indian Press deals at length with the matter, and the *Madras Mail* remarks: "It is just fourteen years since Sir Ronald Ross, working in India—at Secunderabad—discovered the method of transmission of the malaria parasite from man to man by the anopheline mosquito. Malaria causes more sickness and mortality than any other disease in India; yet, knowing all about its method of transmission for the last fourteen years, what has been done in the interval in the way of practical application of the knowledge furnished by Sir Ronald Ross? Nothing! Verily, a prophet is without honour in his own country. There is hardly another country but has something to show —often most brilliant results. Now that the admission has been made that India has hitherto been on the wrong track, we again express the hope that something of a practical nature will shortly be done to mitigate the ravages of malaria in this country."

MR. GEORGE R. M. MURRAY, F.R.S., who died at Stonehaven on December 16, at fifty-three years of age, joined the Department of Botany of the British Museum in 1876, after having spent some time in de Bary's laboratory at Strassburg. He thus started his work at the museum well equipped for the study of the fungi. Murray approached with characteristic enthusiasm the task assigned to him by his chief, Mr. Carruthers, of building up the cryptogamic herbarium. There in the great collections, especially of fungi and algæ, lies the chief record of his work for nearly thirty years. His earlier work was on the fungi, but later he turned to the algæ, and in association with younger workers whom he had attracted to the museum, published a series of papers on the structure and affinities of certain genera. A number of these papers were brought together in the "Phycological Memoirs," which he edited (1892–5). In 1895 was published his "Introduction to the Study of Seaweeds," and in the same year he succeeded Mr. Carruthers as keeper of the Department of Botany. He next turned his attention to marine plankton, and accumulated a large amount of material, much of which he collected himself on various excursions on or across the Atlantic. He embarked on this new work with his usual energy and enthusiasm, but his scientific career was abruptly ended by a breakdown in health that necessitated his retirement. Murray's work was not limited to official duties. As a young man he was known as an able teacher and lecturer. He was for some time lecturer in botany at St. George's Hospital, and later at the Royal Veterinary College; and in conjunction with A. W. Bennett he brought out a text-book on cryptogamic botany. He was secretary to a committee which organised useful work of botanical exploration in the West Indies, and for some sessions he worked hard for his section at the British Association meetings. Until his health failed he was a keen supporter of the Linnean Society, serving on the council almost continuously from 1883 to 1900. He was elected into the Royal Society in 1897.

THE Board of Trade has been informed that the twelfth International Navigation Congress will be opened at Philadelphia on May 23, 1912, under the patronage of President Taft. Further particulars, including the conditions under which persons or corporations may participate in the congress, can be obtained from Lieut.-Colonel Sandford, general secretary of the congress, The Bourse, Room 344, Philadelphia, P.A. (U.S.A.).

THE death is announced, in his fifty-second year, of Mr. James Aitchison, who founded the business of Messrs. Aitchison and Co., opticians, about a quarter of a century ago, and as one of the founders of the Optical Society did much to promote study and research among members of

the optical trade. An obituary notice in *The Times* points out that it was largely through his exertions that technical classes for opticians were formed at the Northampton Institute, Clerkenwell. Mr. Aitchison was one of the prime movers in calling the Optical Convention in 1905, and he was treasurer of the guarantee fund for the Optical Convention to be held next year.

THE death of Sir J. C. Inglis, the general manager of the Great Western Railway, occurred on December 19. From an obituary notice in *The Times* we learn that, as engineer to the Cattewater Harbour Commissioners, he constructed the Mount Batten breakwater at Plymouth, and subsequently was responsible for the Princetown Railway, Newlyn Harbour, and the Bodmin Railway. He became a member of the council of the Institution of Civil Engineers in 1897, and was elected president of the institution in 1908, and again for a second term in the following year, one of his last official acts in that capacity being the laying of the foundation-stone of the new building in October of last year. He was a member of the Royal Commission on Canals and Inland Navigations.

THE Paris correspondent of *The Times* announces the death of three distinguished scientific men, namely, Prof. Lannelongue, M. Radau, and Prof. P. Topinard. Prof. Lannelongue, who died on December 21, in his seventy-second year, was appointed in 1884 to the chair of pathology in the University of Paris, and later he exchanged this appointment for the professorship of clinical surgery. At the time of his death he was president of the Academy of Medicine, and was elected to the Academy of Sciences in 1895.—M. Radau, who was seventy-seven years of age, was a member of the Bureau des Longitudes and of the Academy of Sciences. For many years he contributed articles on astronomy to the *Revue des Deux Mondes*, and he was the author of "Mémoires d'Astronomie," among other works.—Prof. Paul Topinard, the distinguished French anthropologist, was born in 1830. From 1872 to 1880 he was in charge of the collections of the Anthropological Society, and in 1876 was appointed professor at the School of Anthropology.

THE following lectures will be delivered at the Royal Sanitary Institute during January, 1912:—"Fresh Air," Prof. H. R. Kenwood; "Problem of After-care of Sanatoria Patients," Dr. T. D. Lister; "Employment of Patients in Sanatoria," Mr. M. S. Paterson; "Anti-tuberculosis Dispensaries," Dr. D. J. Williamson; "Open-air Schools," Prof. R. P. Williams. These lectures are arranged in connection with an exhibition illustrating the materials and methods of construction of economical forms of sanatoria schools, hospitals, and other temporary buildings, to be held in the museum during January.

THE jubilee annual meeting of the Yorkshire Naturalists' Union was held at Heckmondwike, on December 16, at the place where fifty years ago the union had its birth. There were more than three hundred members present, including delegates from thirty-eight affiliated societies of the Yorkshire Naturalists' Union. The presidential address of Mr. Alfred Harker, F.R.S., on "Petrology in Yorkshire," was delivered. Mr. T. Sheppard resigned his position as honorary secretary, and in view of his nine years' work in that position was elected an honorary life member of the union. Mr. W. Cash was similarly honoured. Mr. J. W. Taylor, of Leeds, was elected president for 1912. The new secretaries are Dr. T. W. Woodhead, and Mr. W. E. L. Wattam, Technical College, Huddersfield. The annual meeting for 1912 will be held at Hull on December 14.

A VALUABLE contribution to our knowledge of the use of iron in early Egyptian times has been made by a discovery during the excavation of the pre-dynastic cemetery of El Gerzeh, about forty miles south of Cairo, reported in the December issue of *Man*. Here, in an undisturbed tomb, a set of iron beads, associated with others of gold, carnelian, and agate, was found on a corpse. Prof. W. Gowland reports that they consist of hydrated ferric oxide, none of the original iron having escaped oxidation.

THE part played by the Jews in the preservation and revival of learning during the Middle Ages is the subject of a scholarly pamphlet by Dr. M. I. Schleiden. Agriculture, the greater industries, such as silk-growing, dyeing, and weaving, were all encouraged by them. The writer claims that they left no branch of science and learning untouched, and at the close of the Middle Ages handed on the results of their labours to the races which were now rising to a sense of their responsibilities. The value of the pamphlet is enhanced by full references to the literature of the question.

IN the seventh Bulletin of the Archæological Survey of Nubia, the exploration gradually extends southwards. While the early pre-dynastic and middle periods are unrepresented, the number of early dynastic graves shows little signs of diminution, and their contents are actually richer, indicating the centre of an early dynastic culture of a Nubian type, characterised by remarkable local types of pottery, copper implements, gold work, and stone work typical of Egypt in the latest pre-dynastic period or in the first dynasty. The crania collected have been sent to this country for examination by Prof. Elliot Smith, but, so far as the material has been examined, it indicates early negro immigration with a possible admixture of other racial elements.

IN the first part of vol. v. of the Journal of the Gypsy Lore Society several correspondents contribute accounts of the funeral rites of a well-known member of the tribe, Isaac Heron, who died last year at Sutton-on-Trent. Gypsy rites of interment have perhaps never been more carefully examined than in this valuable contribution. The corpse was buried in an oak coffin large enough to admit the body, which was dressed in stockings, pants, and a white linen shirt, and covered with a white shroud. Under the corpse his overcoat, lounge coat, waistcoat, and trousers, all of which were turned inside out, were laid. Some money and jewellery, the amount of which was not disclosed, were placed in the pockets of the dead man. After the funeral, which was performed in a Christian cemetery, his van was dismantled. The wheels, shafts, harness, and horse nosebag were placed inside, the contents were soaked in paraffin, and the conveyance was burnt. Among other peculiar features of the rite, the hands of the dead man were laid close to his sides, and a candle was kept burning from the time of death until the body was removed.

THREE papers in the second part of *Sitber. Naturhist. Verein d. preus. Rheinlande u. Westfalens* are devoted to the fauna of Lake Laacher (Laacher See), near Andernach, Messrs. R. Schauss, C. Röttgen, and O. le Roi dealing respectively with the crustaceans, the beetles, and the molluscs.

IN the report for 1911, the committee of the Bristol Museum and Art Gallery records the debt of gratitude owed by the city to the late Lord Winterstoke, by whom the Art Gallery and a considerable proportion of its contents were presented. When this gallery was opened in 1905 it contained very few pictures, whereas the value of those

now exhibited is estimated at 42,000*l*. In recording the loan of a collection of big-game heads from British East Africa, the compiler of the report includes in the list the white-tailed gnu and the blesbok, both of which are exclusively southern species. Possibly the first name may be a mistake for the white-bearded gnu, but it is difficult to guess what species has been mistaken for the blesbok.

IN the Proceedings of the Zoological Society for 1902 Mr. R. Shelford recorded the mimicry of wasps belonging to two distinct genera by Bornean longicorn beetles of the genus Nothopeus, the imitation extending not only to form and colouring, but likewise to habits, and being so close that native collectors could with difficulty be induced to catch the beetles. A third instance of such mimicry has been described in West Africa in the case of a beetle allied to Nothopeus, the mimicked wasp being a fossorial species. To these instances Mr. C. Ritsema (Notes Leyden Mus., vol. xxxiv., part i.) adds a fourth, in which the widely spread *N. hemipterus* imitates in Nias Island the fossorial wasp *Macromeris splendida*, both insects being black with a pronounced metallic-blue sheen, especially on the wings. The author suggests that each of the eight species of Nothopeus mimics a wasp.

IN 1882 Sir R. Owen described the remains of a turtle from the Cretaceous of Queensland as the type of a new genus and species under the name of *Notochelys costata*, the generic name being subsequently changed, on account of preoccupation, to Notochelone. Until quite recently nothing more has been known of this reptile; but in No. 10 of the Annals of the Queensland Museum Mr. C. W. de Vis provisionally refers to it two imperfect skulls from, presumably, the same horizon in another part of the country. The larger and less imperfect of these indicates a turtle apparently nearly allied to existing forms, the symphysis of the lower jaw being short, and thereby indicating that the suggested affinity with the Eocene Lytoloma (Cat. Foss. Rept. Brit. Mus., part iii.) is invalid. In describing the second specimen, which he regards as an immature skull, Mr. de Vis states that "the sclerotic plates are in place," thereby unconsciously showing, if the identification be correct, that it is not chelonian at all. Moreover, the tooth-like projections on the margins of the jaw described as "pseudodonts" appear from the figure to be true teeth, recalling those of mosasaurians. Whatever may be the nature of this problematical specimen, it certainly does not justify the assertion that Notochelone is a generalised type which cannot be included in any existing family.

DR. C. GORINI, writing in the *Atti dei Lincei*, xxi. (2), 6, describes some interesting observations on the microbiology of cheese. It appears that certain acidopresamigenous and acidoproteolytic bacteria are capable of existing at such low temperatures as 10° to 50° C., and thus the ripening of cheese can take place during winter storage. Moreover, the enzymes of these bacteria continue to act at even lower temperatures.

A SHORT flora of Cambridge forms the subject of part iii., vol. xvi., of the Cambridge Philosophical Society's Proceedings, the author being Mr. A. H. Evans, of Clare College. It is prefaced by a short historical account of the chief Cambridgeshire botanists. Unlike Babington, the author classifies the districts of the county according to their geological formation. In addition to phanerogams, ferns, and Characeæ, the flora contains lists of mosses and lichens by the Rev. P. G. M. Rhodes; algæ, including diatoms, by Dr. G. S. West; and fungi, by Mr. F. T. Brooks.

WE have received the current number of the National Poultry Organisation Society, which deals with several minor but important problems in connection with the poultry industry, especially with the cooperative aspects, which it aims at fostering. The value of our imports of eggs and poultry continues to increase, and during the first eight months of this year amounted to nearly $4\frac{3}{4}$ million pounds sterling, nearly half of which came from Denmark.

ONLY a short time ago we had to chronicle the foundation by the Americans in the Philippines of an agricultural college and a journal, *The Philippine Agriculturalist and Forester*. The first numbers contained articles of local interest only, but No. 5, now to hand, already contains a very presentable investigation into the effects of some stimulants upon rice. The additions to soil cultures of small quantities of borax, manganese sulphate, mercury chloride, ferrous sulphate, nickel sulphate, zinc sulphate, and aluminium sulphate produced favourable effects, whilst copper sulphate was harmful.

THREE years ago the Behar Planters' Association appointed an expert to conduct experiments for the purpose of ascertaining whether flax could be profitably grown and manufactured on Indian estates, the buildings and vats of which could be utilised for retting and scutching. A report has now been issued showing the financial returns during the past season, and thus putting the planters in a position to judge whether the new crop is as profitable as indigo. The quality of the flax is satisfactory, good prices being also obtained for the seed. The report forms Bulletin 25 of the Agricultural Research Institute, Pusa.

THE current number of *The Agricultural Journal of the Union of South Africa* contains the unpleasant news that the much-dreaded San José scale, *Aspidiotus perniciosus*, Comstock, has found its way into the Transvaal. The discovery was made by Mr. J. W. Moore, of Potchefstroom, in working up a collection, and steps were at once taken to exterminate the pest. In the same journal an account is given of a new and very promising breed of maize picked out from a crop of Hickory King that had grown alongside Virginia horsetooth. Hitherto the yield has proved exceedingly good.

AMONG the sclerophyllous woodlands recognised by Dr. Schimper as a feature of those regions situated in the warm temperate zone where the rainfall coincides with winter is the chaparral, or dwarf forest of southern California. An account of this formation by Mr. F. G. Plummer, published by the United States Department of Agriculture as Bulletin 85 of the Forest Service, indicates that it is a truly natural type, occurring between the altitudes of sea-level and 8000 feet, and confined to the littoral district from Monterey to San Diego. True chaparral consists primarily of dwarf trees—not shrubs—stunted by reason of an insufficient rainfall. It is economically important as a ground cover for the watershed whence the water supply is obtained for irrigation and municipal purposes. About forty different species of trees are combined in the formation; the most desirable are those which produce good shade, are not inflammable and make vigorous growth, such as *Rhus laurina*, *Prunus ilicifolia*, *Heteromeles arbutifolia*, and species of Quercus; less desirable, but dominant are species of Adenostoma and Ceanothus.

THE fifteenth volume of Transactions of the Leicester Literary and Philosophical Society, 1911, has a paper by Mr. H. Quilter suggesting an explanation of the presence of *Sambucus Ebulus*, the dwarf elder, or Danewort, in Leicestershire, and perhaps in Great Britain generally. It

is usually regarded as an introduced plant, and popularly supposed to have been brought by the Danes. The seven localities where it is recorded contain Roman remains. Anglo-Saxon medicinal books, deriving from Roman sources, mention the shrub under the names Low-wyrt and Weal-wyrt, the latter term implying that it was a denizen. The name Danewort does not occur until 1538. Mr. S. B. Bratley has some interesting notes on micrococci from diseased larvæ. Among other evidences of the work being done by the society in the popularisation of science is a good lecture on trees by Mrs. C. D. Nuttall. This contains a useful sketch of afforestation problems, and an interesting reference to the work of the Midland Reafforestation Association. Successful experiments have been made in raising plantations of trees on the waste coal surfaces and pit mounds of the Black Country. Some trees are growing well in pure coal-dust. The poplar, willow, ash, sycamore, and Wych elm do best. Oaks and conifers take less kindly to the peculiar atmosphere and soil. This is an interesting undertaking.

ABOUT three years ago the attention of the Royal Dublin Society was directed to the occurrence of considerable deposits of modern marine shells west of Mallaranny, in Co. Mayo, at heights of from 100 to 800 feet above sea-level. Mr. J. de W. Hinch (*Irish Naturalist*, 1911, p. 189) has now cleared up any doubts regarding their origin, by showing that the common limpet is by far the most prevalent form in these deposits; that the other species present are all edible; and that traces of fire occur on the sites where they occur. Mr. Hinch concludes:—"The deposit is certainly not a raised beach, nor a Glacial deposit. In my opinion it is a rock shelter of prehistoric times." The modern talus has in places grown over and entombed a large number of the shells.

MR. J. M. CLARKE has published in a separate form his "Observations on the Magdalen Islands" (New York State Museum Bulletin 149, 1911). These islands lie in the Gulf of St. Lawrence, north-east of Prince Edward Island, and are quaintly described as "sea-wracked [racked?] remnants of continental land." They are occupied by about 7000 persons, chiefly of French origin. A new term is introduced (p. 12), the "*demoiselle hills*; rounded, symmetrical, beehive-shaped elevations with grassy surfaces and separated by shallow or deep cauldron-like depressions." It appears that this term refers to what may be styled, on the same grounds, mammillations; the form, as we know in Jura, has always appealed thus to navigators. Mr. J. W. Beede describes and illustrates the Lower Carboniferous fossils from the islands, including several new species of Productus.

THE Bulletin of St. Louis University, vol. vii., No. 5, treats of seismology. At this university a Wiechert 80 kg. horizontal seismograph has been established. The records are made on a surface of smoked paper. From January to June, 1908, 19 disturbances were noted. During the same period, but with apparatus which records photographically, we see that 52 earthquakes were noted at Victoria, B.C., 47 at Toronto, 160 at Hamburgh, and 108 at Stonyhurst. All these observations have been corroborated by records obtained at other stations, and are therefore known to represent earthquakes which have disturbed very large areas. Fifteen colleges in the United States and one in Canada have been equipped with instruments similar to the type adopted at St. Louis.

To *The Monthly Weather Review* for May, published by the U.S. Weather Bureau, Dr. O. L. Fassig contributes an interesting article on "The Trade Winds in Porto Rico," based on hourly observations for ten to twelve years at San Juan. The island lies wholly within the zone of the north-east trades, and the tables show a prevailing wind-direction from north-east to south-east during 77 per cent. of the entire year, or an aggregate of 281 days, and from south during 14 per cent., or 51 days. In the diurnal period, from about 9h. a.m. to 10h. p.m., the prevailing direction is from the east for the entire year, and from 10h. p.m. to 9h. a.m. from the south-east. The night winds, being lighter, vary somewhat more than those of the day. The average hourly wind-velocity for the year is about 11 miles; the minimum, 6 miles, occurs at sunrise, and the maximum, 16 miles, at about 2h. p.m. Judging from the movements of the clouds, the average depth of the trade-wind current probably does not exceed 10,000 feet; the lower clouds are wholly within the trade-wind drift. The changes in temperature due to change in the direction of the wind are, as a rule, very small.

IN a paper on the analytical basis of non-Euclidean geometry (*American Journal of Mathematics*, xxxiii., 3) Dr. W. H. Young, F.R.S., makes the following suggestive remarks:—"There is, it seems to me, a tendency at the present time to throw dust in the eyes of the mathematical public, or rather of the schoolboy public, in respect of the step taken which corresponds to Euclid's eleventh axiom. To efforts, now recognised by all mathematicians to be abortive, towards proving the eleventh axiom have succeeded treatments of the subject-matter of Euclid for future engineers and others which seem to gloze over the difficulty this axiom involves. I have recently proposed" (Quarterly Journal, 1910, pp. 353–63) "to emphasise the empirical character of the axiom by giving it a form which challenges attention, a form, moreover, having the double advantage that it relates to bounded space, and can be experimentally verified by the dullest schoolboy, even by one to whom the ideas of an angle represents an incompletely solved difficulty. If, on the other hand, we leave the region of school books, we find for the most part an air of unreality and half-heartedness in the treatment of the subject." In his present paper Dr. Young shows how the refinements of modern analysis give a consistent account of the three geometries which arise out of the alternatives for the eleventh axiom.

MESSRS. BURROUGHS, WELLCOME AND CO. have sent us a copy of the "Wellcome" Photographic Exposure Record and Diary for the year 1912. This, as many of our photographic readers are aware, consists of a very neat, nicely and strongly got-up pocket-book, and contains the essence of photographic information in tabloid form. In it are given the directions and observations on such matters as exposure, development, intensification, and the other procedures which go to the making of pictures. The information is very general, and the user of any plate or camera will find it equally serviceable. Instructions and explanations are given with regard to such topics as factorial and time development, machine, tank or stand development, the oil-pigment process, contact printing by artificial light, colour photography, &c. All the figures and factors, based upon actual experiment, have been worked out for all the principal films and plates, and are collected in a neat, convenient form. By the ingenious exposure calculator attached to the cover, correct exposures under all circumstances can be easily secured. In addition to all this photographic information, there are pages for diary and exposure notes, so that the book serves as a pocket-book as well as a work of reference. It should be noted that three separate editions of the pocket-book are pub-

lished, specially adapted for the northern hemisphere and tropics, the southern hemisphere and tropics, and the United States. Those who have not yet taken advantage of the valuable aid this pocket-book is when travelling about the world, or even staying at home, should make the experiment now and use one. The writer has for several years always possessed himself of a copy, and while he has had the occasion to employ all the three editions, he has found them most valuable in making the exposures, in recording the data, and in many other useful ways.

SOME novel conclusions in reference to the osmotic pressure of colloids are given by Messrs. Moore, Roaf, and Webster in the October issue of *The Biochemical Journal*, in a paper on the osmotic pressure of casein in alkaline solutions. It has sometimes been suggested that the osmotic pressure of such substances is due to the presence in them of small quantities of ash. But it is found experimentally that alkali moves against the osmotic pressure to the same side of the membrane as the colloid, with which it enters into combination. The authors conclude that the supposed impermeability of the membrane to ions is fictitious, and that its function is merely to hold together the colloidal aggregates by which the crystalloid is attracted and made to traverse the membrane. The thirst of the casein for alkali illustrates the manner in which the colloids of living cells can extract and concentrate crystalloids for their purposes from infinitesimally low amounts in the fluids bathing them, such, for example, as bone formation from the excessively low concentration of calcium ion in the blood, the formation of calcareous and siliceous shells in fresh-water and marine organisms, and many similar cases. Such concentrations arise from affinities of a molecular type between colloids and crystalloids, which vary from time to time, so causing periods of uptake and deposition in a rhythmic manner.

THE Patent Office Library is well known to all scientific workers in London. The liberal yet careful manner in which additions are made to the library, the wide range of scientific periodicals and journals, and the fact that it is available from 10 a.m. to 10 p.m., places the library in a unique position in London. The bookshelves are open to the visitors, a much appreciated privilege, but one requiring an intimate knowledge of the system of classification adopted if the time of the visitor and officials is not to be wasted. The new series of subject lists now being issued, while preserving the same form and general arrangement as the former one, is arranged so that the headings contain certain marks indicating the location of classes of books in the library. The most recent subject list in the new series deals with works on peat, destructive distillation, artificial lighting, mineral oils and waxes, gas lighting, and acetylene. It forms a pamphlet of 104 pages, and is obtainable at the Patent Office for 6*d*.

THE causes of variations in the mineral oils of the United States and other countries have given rise to many investigations and discussions. Not only do these differences exist in oils found in separate regions, but there are extreme variations in many oils occurring in adjacent localities. It is a plausible hypothesis that the transport of the oil from the lower strata may have been effected, or at least assisted, by capillary action, and during the passage upwards a fractionation of the oil will take place. Day showed that the unsaturated hydrocarbons are less diffusible than the paraffin hydrocarbons, and Gilpin and Cram confirmed and extended this view by showing that when petroleum is allowed to diffuse through tubes packed with Fuller's earth, the unsaturated hydrocarbons collect in the earth of lower sections of the tubes, while the paraffins tend to accumulate in the lightest fraction at the top of the tube. Similar experiments have been made by other observers. Additional evidence is given in Bulletin 475 of the United States Geological Survey, on "The Diffusion of Crude Petroleum through Fuller's Earth, with Notes on its Geologic Significance," by J. Elliot Gilpin and Oscar E. Bransky. They show that when mixtures of benzene and a paraffin oil are allowed to diffuse upward through a tube packed with Fuller's earth, the benzene tends to collect in the lower sections, and the paraffin oil in the upper, sections of the tube. Crude petroleum under similar conditions also undergoes a fractionation, and repeated fractionation showed that there is a tendency to the production of mixtures which will finally pass through the earth unaltered. Fuller's earth tends to retain the unsaturated hydrocarbons and sulphur compounds in petroleum, thus exercising a selective action upon the oil.

WE have received a reprint from the *Rivista di Fisica Matematica e Scienze Naturali*, Pavia, of a suggestive memoir by Prof. P. Palladino entitled "Les Composés Chimiques dans l'Espace," in which some novel ideas as to the constitution of matter are put forward. The basis of the hypothesis is stated to be essentially "the unity of matter and its possible groupings," and the author believes he has arrived at the form and relative dimensions of the atomic groupings of the unit of matter, or "quantities of combination," of the chemical elements. The memoir is illustrated by seventy-two geometrical figures representing the structure of the atoms and molecules of the principal elements and their compounds, and the text is interspersed with numerous graphic symbols, which act as a convenient notation to represent these various geometrical shapes of the elementary atoms and the molecules of their compounds. Definite shape is attributed to the unit of matter, namely, that of a tetrahedron; thus, for instance, the atoms of oxygen and of phosphorus are supposed to be built up of five tetrahedra, while those of hydrogen are composed of five polytetrahedra, each in turn composed of five smaller tetrahedra. The unit tetrahedron is supposed to be, in turn, composed of a number of electrons. The tetrahedra may be arranged in either a closed or an open manner in many cases, such as in those of oxygen and phosphorus, the difference of structure accounting for the existence of two forms of the same element, the less stable form (such as yellow phosphorus) corresponding to the open arrangement, and the more stable (red phosphorus, for example) to the closed assemblage. Prof. Palladino traces numerous chemical reactions and physical relationships to the forms which he thus attributes to the elementary atoms and the molecules of their compounds, and the whole memoir is both ingenious and highly suggestive.

A SECOND edition of Dr. Arnold Berliner's "Lehrbuch der Experimentalphysik in elementarer Darstellung" has been published by Mr. Gustav Fischer, of Jena. The first edition of the work was reviewed in the issue of NATURE for August 4, 1904 (vol. lxxiv., p. 317).

UNDER the title "Abhandlungen über Dialyse (Kolloide)," three of Thomas Graham's papers have been issued as No. 179 of Ostwald's *Klassiker der Exacten Wissenschaften*. The translation has been made by E. Jordis, who has also added a biography and bibliography, together with a series of critical notes.

Erratum.—In the summary of Dr. Tutton's Cantor lectures on "Rock Crystal," given in NATURE of December 21, a line of type was unfortunately omitted.

After line 20 from the bottom of column 2 on p. 264, ending with the words "known as," and before the next printed line beginning "twins," there should have appeared a line reading "amethyst. There are two well-marked kinds of quartz". Also the adjacent Fig. 14 should be vertically inverted.

OUR ASTRONOMICAL COLUMN.

SCHAUMASSE'S COMET, 1911*h*.—MM. Fayet and Schaumasse publish a set of elements and an ephemeris for comet 1911*h* in No. 4542 of the *Astronomische Nachrichten*. The ephemeris gives the positions of the comet to the end of March, 1912, and shows that the object should attain its greatest apparent brightness about the beginning of February, when it should be of about the tenth magnitude; the following is an extract:—

Ephemeris 12h. M.T. Paris.

1912	α	δ	$\log r$	$\log \Delta$	$1/r^2\Delta^2$
	h. m.	° ′			
Jan. 1	15 17·5	− 1 49	0·1116	0·2008	0·24
,, 9	15 52·4	− 3 43	0·0953	0·1899	0·30
,, 17	16 27·7	− 5 28	0·0822	0·1835	0·30
,, 25	17 3·0	− 7 2	0·0732	0·1813	0·31
Feb. 2	17 37·5	− 8 21	0·0689	0·1830	0·31
,, 9	18 10·9	− 9 25	0·0696	0·1877	0·30

This path lies through the southern parts of Serpens and Hercules, then through Ophiuchus and Aquila; the comet will pass about 3° north of Altair on March 9, 1912, and will remain a morning object throughout.

BROOKS'S COMET, 1911*c*.—Prof. Millosevich publishes an ephemeris, extending to March 3, for comet 1911*c* in No. 4542 of the *Astronomische Nachrichten*. The comet is now too far south for observation in our latitude, but was observed by Dr. Ristenpart at Santiago on December 9; its magnitude then was 7·5, and the observed position gave corrections of +7·6s. and +3·0′ to the ephemeris position.

In the same journal Dr. H. E. Lau records the magnitude observations made at the Treptow Observatory during the period August 26 to October 10. Comparing the observed with the calculated magnitudes, he finds that the former fit $1/r^2\Delta^4$ better than $1/r^2\Delta^2$; there is also a suggestion of a periodic oscillation in the observed magnitudes. Other magnitude observations are given, and Father Iniguez also gives the wave-lengths of the lines observed photographically and visually in the spectrum of the comet.

OBSERVATIONS OF MARS.—A telegram from M. Antoniadi to the *Astronomische Nachrichten* (No. 4542) states that the large telescope at Meudon revealed, on December 6, a singular brown spot to the areographic west of Argyre. On November 14 the same observer and M. Bosler were struck by the decided citron hue of the planet's surface, even the polar snows appearing yellowish. On December 4 and 6 the Solis Lacus region was seen, under good conditions, to be as it was in 1909, but the "lake" itself was more intense. It was on the second date that the large brown spot was seen situated in the western part of the M. Erythræum. Such a spot, although much weaker and uncertain, has been seen during previous oppositions, but never so plainly as now; it is about 600 kilometres long, and its coloration is entirely different from that of any other feature on the planet.

THE TOTAL SOLAR ECLIPSE OF APRIL 17, 1912.—In a paper read before the British Astronomical Association, and published in the current Journal (vol. xxii., No. 2), Mr. G. F. Chambers gives a number of interesting particulars he has collected concerning possible facilities for seeing the total solar eclipse of April 17, 1912. According to the different almanacs, maximum duration, which occurs in Portugal, will be from 0·6s. to 8·0s., the former being given by *The Nautical Almanac*, the latter by the *Berliner Jahrbuch*; the *Connaissance des Temps* gives 6·3 seconds. Mr. Chambers gives the times of sailing of ships to various ports in the peninsula, particulars as to methods of reaching, and accommodation in, the towns near to the eclipse path, and some idea of the cost. From figures supplied by Father Iniguez, the meteorological conditions at the Spanish stations would probably be unfavourable; and, on the whole, Ovar in Portugal, about eighteen miles south of Oporto, seems to promise the best chance of seeing the transitory phenomena. A party is being organised by Mr. Chambers, and intending participants should communicate with him.

PLANETARY ATMOSPHERES.—An interesting study of the production, the effects, and the disappearance of the atmospheres of planets is published by Prof. Arrhenius in the *Publications de la Société de Chimie Physique*. Starting with each planet as a separated portion of the solar nebula, the author traces out the general method whereby the metals, the hydrocarbons, &c., would become solidified parts of the planet's crust, and then shows how this would operate in the case of the earth. Carbonic acid would be the most resistant impurity of the atmosphere, and under the action of plant life and light would become decomposed. With less CO_2 the radiation would increase and the temperature of the earth's crust would decrease. Volcanic action would then interfere by producing more CO_2, and so an oscillation of temperature and climate would ensue. Prof. Arrhenius is unable to accept the long-period rotation of Venus, and describes a development on that planet which will be richer and more brief than it has been on the earth. Turning to Mars, he likens the conditions there to those obtaining in certain desert districts, *e.g.* parts of Persia, only the temperature is some 30° below zero according to him. The Martian "lakes" are analogous to the semi-solid ***khévirs*** found in Persia, and Prof. Arrhenius shows how the colours and the changes on Mars can be fitted with terrestrial equivalents of this type.

INTERNATIONAL SOLAR RESEARCH.[1]

THE interesting volume referred to below gives evidence of so much progress since the last meeting of the Solar Union at Meudon in 1907 that it is not possible in a limited notice to do more than mention some of the chief contents.

After giving a list of members of the scientific bodies constituting the union, and the names of those who attended the fourth conference at Mount Wilson, the minutes of each of the four meetings held on August 31, September 1 and 2, 1910, are given verbatim. At the first meeting, with Prof. E. C. Pickering in the chair, Dr. G. E. Hale gave a lengthy address on the recent developments of solar investigation. The preparation of the new sunspot map has been delayed by the necessity of arranging for spectra of greater dispersion to allow of the proper analysis of the Zeeman effect in spot spectra. It was decided that the scale should be not less than 5 mm. to 1Å the separate sections not exceeding 60 cm. in length. In the progress of work on comparisons between centre and limb, solar chromosphere and other allied problems, the question of the Tertiary standards is important, and it is proposed to undertake their determination in the near future. Dr. Hale also gave a very lucid description of the details of the new large tower telescope and spectrograph. Certain changes detected in the spectra of sunspots were outlined, the differences found being due to the varying strengths of magnetic field in the spot vortices, giving different separation of the components. An important statement is that the record of eruptive phenomena can be carried on with Hα better than with the calcium lines, and these eruptive phenomena are likely to be associated with magnetic storms on the earth.

A number of important resolutions by the Wave-length Committee were adopted, from which it is apparent that there is a good prospect of spectroscopists being provided in the near future with a trustworthy table of wave-length standards showing all the lines of most of the known elements on a uniform system. These will be referred to a number of "secondary standard" iron lines which have been determined by Fabry, Eversheim, and Pfund.

At the second sitting, Prof. W. W. Campbell in the chair, reports were presented dealing with solar radiation, spectra of sunspots, eclipse observations, &c. From an exhaustive

[1] "Transactions of the International Union for Cooperation in Solar Research." Vol. iii. (Fourth Conference). Pp. viii+231. (Manchester: University Press, 1911.) Price 7s. 6d. net.

series of pyrheliometric determinations at Washington (sea-level), Mt. Wilson (1800 metres), and Mt. Whitney (4420 metres), Mr. Abbot concludes that the most trustworthy value of the "solar constant" is 1·95 calories per sq. cm. per minute.

An important resolution was adopted providing that in future position angles round the sun's limb should be measured from the north to the east. This is opposite to the procedure followed during the last forty years in Italy, but Prof. Ricco thought that the Soc. degli Spettroscopisti Italiani would now be willing to agree to the change, in order that all observers should have the advantage of a uniform system.

In the reports on sunspot spectra the concurrent result is that the various metallic lines are, on the whole, affected in a systematic manner, such that the arc-flame lines are strengthened, normal arc lines unaffected, and enhanced (spark) lines weakened in spots. Certain elements—vanadium, titanium, scandium, &c.—show greater tendency to strengthening than others. With regard to the question of variation, it is evident that at least during the period of five years about the last maximum, no decided changes have been evident in the general spot spectrum. With instruments of very large dispersion certain changes have been noticed which, as before mentioned, are attributed to variations of intensity in the magnetic field of the spot vortex. Six observers have agreed to subdivide the region B—F for the continuance of visual observations of special phenomena.

The third session, presided over by Prof. E. B. Frost, was occupied with reports on the observations of solar rotation, work with the spectroheliograph, and an address by M. H. Deslandres on the "Motions and Forms of Solar Vapours."

The concluding sitting was mainly occupied with questions of administration, the chief point of interest being the enthusiastic adoption of a motion to extend the scope of the union to include astrophysics. A committee was appointed to examine and report on the question of classification of stellar spectra.

It was announced that in all probability a solar observatory would be established in Japan in the near future.

The next meeting of the Solar Union will be held in Bonn in 1913.

CHARLES P. BUTLER.

THE ORIGIN OF MAMMALS.

AN outstanding feature of the zoological section at the Portsmouth meeting of the British Association was an excellent discussion on the above subject, in opening which Prof. G. Elliot Smith laid special stress on the influence exerted by the evolution of the brain in making mammals what they are and in supplying evidence showing whence they came. He pointed out that while all living marsupials are specialised in greater or less degree, so that no one of them can be looked upon as ancestral to the Eutheria, it must be admitted that the more highly specialised Eutheria must have passed, in the course of their phylogeny, through a stage not very different from that represented by Perameles, and that therefore there was a metatherian stage in the ancestry of the Eutheria. The mode of development of the blastocyst and the presence of a shell membrane, the arrangement of the hippocampal formation and cerebral commissure, and many other structural features, indicate that in most respects the marsupials have retained, in far greater measure than the Eutheria, the features distinctive of their common ancestor. Turning to the monotremes, not only is the skin and its hairy and glandular epithelium typically mammalian, but also the alimentary canal and liver, the diaphragm, the auditory ossicles and their mode of development, and the organ of Jacobson; in the brain the complex specialisation of the hippocampal formation and its curious fascia dentata—so peculiarly distinctive of Mammalia—is carried to a degree of differentiation at least as great as in other mammals; the characteristically mammalian neopallium is present, and emits a system of projection fibres forming pyramidal and cerebro-pontine connections, as in other mammals.

These and other facts demonstrate the kinship of monotremes to other mammals, and establish the monophyletic derivation of the Mammalia. But living monotremes are separated by a wide interval from Meta- and Eutheria. At a very early stage in the history of Mammalia, soon after the acquisition of skin, hair, milk glands, and the appearance of the typical hippocampus and neopallium, the Prototheria divided into two phyla, one of which retained the generalised features and the other specialised. From the former the common metatherian ancestors of all the Metatheria and Eutheria sprang by gradual transformation; from the latter were derived the living monotremes, which display a high degree of specialisation in association with the fixation of certain very primitive phases of mammalian structure, showing what the primitive mammal, just emerged from the reptilian stage, was like. All mammals have sprung from an oviparous prototherian stock, which, though vastly different from living monotremes, still deserved the name Prototheria; and there is an overwhelming mass of evidence—anatomical, embryological, and palæontological—to prove that the mammalian phylum sprang from the Reptilia, although certain features—the occipital condyles, the mesenteric vessels, the epiglottis, the mode of development of the heart, the nature of the skin and its sense organs, the auditory ossicles, and the early phases of the eutherian blastocyst—have been cited as arguments for an amphibian, in opposition to a reptilian, ancestry for mammals. But Hill has demonstrated the thoroughly sauropsidan derivation of the mammalian mode of blastocyst formation, while Osborn, Broom, and others have shown that the bicondylar arrangement of the amphibian occipital bone has persisted in many extinct reptiles, and especially in the Theriodonts, which present such a remarkable series of mammalian resemblances in their skeletons.

The process of differentiation of the mammalian hippocampal formation becomes intelligible only when the preparatory phases, represented in the reptilian brain, are known. In the amphibian brain, on the contrary, the cortical formation has become so specialised, or perhaps so degenerate, in comparison with that of its forerunner—the Dipnoi—or its successor—the Reptilia—that it must be regarded as being off the path which led to the Mammalia. In spite of the certainty that the mammalian brain passed through a reptilian stage in its phylogeny, the brain of no living reptile fulfils the conditions required in the actual ancestor of the Pro-mammalia. The brain of Sphenodon represents a blending of primitive features with lacertilian and chelonian characters, but it inclines too decidedly to the Lacertilia to afford a type of the ancestral reptilian brain. The extinct Therapsida (including Cynodontia) present a blend of primitive reptilian and primitive mammalian features, many of the characters of the skull of Rhynchocephalia, of the polyprotodont marsupials, and of the Insectivora being reproduced with surprising exactitude, as Watson has recently shown, and in the limbs prototherian peculiarities are often closely foreshadowed. If the actual ancestor be not discovered, the group of Cynodontia provides so many forms presenting mammalian characters of skull and teeth, limbs and trunk, that it is no longer possible to refuse to recognise these extinct forms as the representatives of the order to which the ancestor of the Prototheria belonged. Prof. Elliot Smith held that the ancestor of the Mammalia was scaly and laid eggs provided with a large amount of yolk, to mention only two obvious points among the definitely reptilian characteristics of the Pro-mammalia, and repeated that there is an extinct group of reptiles—the Cynodontia—which includes representatives conforming in almost every detail of structure to what would be expected in the near relatives of the earliest mammals, whereas there is no group of Amphibia which fulfils these conditions.

It seems impossible to derive either reptiles or mammals from the true Amphibia. In the course of evolution from the dipnoan stage the amphibian brain has in great measure lost precisely those features which were essential if it had to develop into the reptilian or mammalian condition. The features of the brain in Dipnoi so definitely foreshadow the conditions seen in the Reptilia that it is difficult to believe the Dipnoi can be far removed from the direct path leading to the Amniota; but the dipnoan brain, in its general plan, though not in the histological detail of

its cortex, is essentially amphibian. This fact, taken in conjunction with the palæontological evidence, suggests that the stegocephalian brain may have bridged the interval between those of Dipnoi and Reptilia. Perhaps both Amphibia and Reptilia have been derived from Stegocephalia. Recent research, especially on fossils from the Permian of Texas, has brought to light stegocephalians so closely resembling reptiles, and reptilian remains so stegocephalian, that there can no longer be any question as to the genetic relationship of the two groups.

Prof. Elliot Smith remarked that it is unfortunate that nothing is known of the brain in the Cynodontia, for he thought that the transformation of its cortex must have played a leading part in the evolution of the Mammalia. Broom states that the South African Theriodonts from which mammals were derived became distinguished from their American allies by the development of powerful limbs, and that "it was the lengthened limb that gave the start to the mammals." "When the Therapsidan took to walking with its feet underneath and its body off the ground it first became possible for it to become a warm-blooded animal. All the characters that distinguish a mammal from a reptile are the result of increased activity—the soft flexible skin with hair, the more freely movable jaws, the perfect four-chambered heart, and the warm blood." But Broom confesses his inability to explain how this fateful lengthening of the limbs was caused. Prof. Elliot Smith suggested that a realisation of the changes which took place in the brain in the transition from reptiles to mammals would seem to indicate an explanation of this and the acquisition of many other mammalian features.

The development of a definite neopallium (the cerebral cortex *sensu stricto*), the lengthening of the limbs, the increased activity, the freeing of the skin of its mail-like coat of scales and conversion of it into a highly developed tactile organ—all these events occurred at about the same time, and had a reciprocal influence one upon the other.

By the time the Reptilia were evolved the cerebral hemisphere had reached a stage of development which opened up vast possibilities of new developments. Though the cerebral cortex was still mainly olfactory in function, tactile, gustatory, visual, and perhaps auditory impulses were able to make their entry into it; but it exercised little *direct* control over the movements of the body, which were still regulated by the midbrain. The possession of this potential receptive organ in the cortex for receiving tactile impressions and bringing them into relation with impressions from the other sense organs gave an added importance to the tactile sensibility of the ridges of skin that intervened between the scales of the Hypotherian. Moreover, more precise movements of the limbs became possible, because more exact information was being provided of the positions of the limbs by these tactile impressions.

The enhanced importance of the skin as a tactile organ led to the atrophy of the scales, perhaps by a process of natural selection; and the greater perfection of the tactile sensibility of the skin, and of its receiving and recording apparatus in the cortex, reacted mutually one upon the other and gave birth to the neopallium. It is not without significance that from its earliest appearance the neopallium performed the function of regulating "skilled" movements of the whole body, *i.e.* such actions as are possible only when there is a highly developed tactile information bureau to render nicely adjusted movements possible. Moreover, quickness and increased activity are made possible by the neopallium, because it was put into direct connection *ab initio* with all the motor nuclei in the whole central nervous system by the pyramidal tract (which developed *pari passu* with the evolution of the neopallium), and also with the cerebellum (by the simultaneous development of the pons), which enabled the creature to coordinate the muscular activities of its whole body to perform quick, accurately adjusted, and skilled movements. It is such developments as these that made the mammals what we know them to be, that give them their dominant position and their plasticity, or power of rapid adjustment to varying environment.

It is only when such skilled movements are possible that long limbs, capable of supporting the body, can become useful appendages. The fact that such limbs were making their appearance in the Therapsida in Triassic times is tangible evidence of the birth of the neopallium in these pro-mammals.

Prof. Arthur Keith, in maintaining that mammals arose not from reptiles, but from Amphibia, remarked that the divergence between his views and those of Prof. Elliot Smith was not really so great, as the question involved not the Amphibia and reptiles of the present, but extinct forms in regard to some of which it was difficult to say to which of these phyla they should be referred. The common stock from which reptiles, birds, and mammals had been derived possessed three characters:—(1) an egg giving rise during development to an amnion and allantois; (2) the beginning of a cerebral cortex; and (3) lungs filled and emptied by movements of the body wall. Prof. Keith regarded this common ancestor as more amphibian than otherwise. He devoted special attention to the third character above named, and pointed out there was not in any living reptile a trace of a diaphragm, and that the lungs of reptiles were essentially different in structure from those of mammals, and, further, the movements of the body wall were different in the two phyla. He believed that the evolution of a new type of respiration, in which the whole body wall became a means of expanding the body and filling the lungs, was a great step in advance, and he considered that this occurred in an amphibian stock not far removed from the Dipnoi, and conceived that there was a common type (amphibian) from which the three types of respiration—reptilian, avian, mammalian—had been evolved. He also referred to the presence of His's bundle, which is found only in the heart of mammals, and suggested that this arose in the Dipnoi, and was transmitted through an ancient amphibian. Prof. Keith thought that an early amphibian, arising near the beginning of the Permian, was the stock from which came the higher vertebrates.

Dr. C. W. Andrews remarked that the agreement of the skeleton of Cynodonts with that of mammals is so remarkable that it is impossible to believe it accidental. Possibly in Middle Permian times lived some small animal of this group from which the mammals arose. The shoulder girdle, atlas, and lower jaw of some Theriodonts represented transitions from reptilian to mammalian conditions. The dentary became greatly enlarged, owing to the differentiation of the teeth, especially grinding teeth, extended backwards, and acquired articulation with the squamosal, leaving the quadrate and articulare on the inner side. Some of the South African Therapsida present so close an approach to mammalian characters that it seems impossible to believe that the Mammalia can have arisen from any other group.

Dr. Marett Tims pointed out that if the dentitions of the monotremes and of the Metatheria and Eutheria be considered, the monophyletic derivation of the mammals does not appear to be fully established. In the marsupials and Eutheria generally (leaving the Rodentia out of account for the moment) the dentition is of the *type* which may be referred to as trituberculate, though not of the trituberculate pattern, while the dentition of the monotremes is of an entirely different nature, being referable to that of the fossil Multituberculata. Dr. Tims said that his investigations on the tooth germs of the Caviidæ lend support to the view that, as already urged by Dr. Forsyth Major, the dentition of these rodents has a multituberculate character. On these and other grounds Dr. Tims was disposed to suggest the possibility of the diphyletic origin of mammals, and to believe that monotremes, and possibly rodents (though with much greater doubt), may have sprung from a different stock than that from which the marsupials and remaining Eutheria have arisen.

J. H. A.

VERTICAL CURRENTS IN THE ATMOSPHERE.

IN a paper entitled "Die Messung vertikalen Luftströmungen," Dr. Paul Ludewig, of the University of Königsberg, describes some experiments made in three balloon ascents, for the purpose of determining the vertical currents in the atmosphere. The lack of information on this important point is made painfully evident at intervals in the inquiries into aëronautical disasters. The problem is

being attacked in this country partly by observations of pilot balloons and partly by observations near the earth's surface of the angle of elevation of a balloon, which in a horizontal wind floats very nearly at the same level as the point to which it is attached. Special difficulties arise owing to the rapid increase of the errors of observation in the first method as the balloon travels away from the observers, and to the influence of the instability of the wake in the second method. Dr. Ludewig's contribution will therefore be of special interest. He uses the principle that the barometer in the balloon shows the height above sea-level, and therefore the rate at which the balloon is rising relative to the earth, while a vertical anemometer carried by the balloon shows the rate at which the balloon rises relative to the air. The difference between the two rates gives the rate at which the air is rising relative to the earth or the strength of the vertical current.

The construction of a suitable anemometer is the principal difficulty. Dr. Ludewig uses a fan in a small cylinder, which hangs from the balloon in a vertical position; the revolutions of the fan are recorded photographically by an ingenious device, so that the inertia and friction are reduced to a minimum. When the anemometer was suspended in a horizontal current of air, the fan did not rotate, so that effects arising from variations in the horizontal velocity were practically eliminated. In addition to a barograph, a Bestelmeyer variometer was used. The instrument is a form of eye-reading microbarograph, which permitted of great accuracy in determining the small variations in altitude as the balloon travelled across the country. In the first ascent, made on January 22, 1911, the results obtained from the variometer and the anemometer agreed so closely that it was evident that no vertical currents were present. In the third ascent, on February 18th, when there was a steep gradient for westerly winds over central Europe, strong vertical currents were experienced, and the instrumental measurements showed that the motion was mainly upwards, and reached at times a speed of 3 metres per second at altitudes slightly less than one kilometre. A curve, showing in profile the country passed over by the balloon during the period for which the diagram of vertical motion is drawn, would add interest to the latter and possibly suggest the causes of the rapid variations in the upward current.

E. GOLD.

BEACH-LA-MAR, THE JARGON OF THE WESTERN PACIFIC.

BEACH-LA-MAR is that peculiar variety of English speech which has arisen from the contact of uncultured civilisation with the savage or semi-civilised peoples of the western Pacific. It is a language born of the necessity of comprehension between primitive traders, and is thus, in its nature and purpose, akin to the Lingua Franca of the Levant, the Pidgin of the China Seas, the Chinook of the American fur trade, the Negro-English of the Guiana plantations, and the Krooboy talk of the African coast. Its name suggests but one of its origins, for Beach-la-mar is the sailor's mispronunciation of Bêche-de-mer, a name of the Trepang or Holothuria, which was prepared on the island shores for the markets of the East Indies. But the language began with the American whalers and the sandalwood gatherers of the early nineteenth century, who preceded the *bêche-de-mer* fishers of the 'forties and 'fifties. On the decay of the trepang industry the talk passed to the copra-collectors and the beach-combers, and was finally settled as the jargon of the Pacific by the "blackbirding" (more delicately described as the "recruiting of Polynesian labour") in the 'sixties, when it became the common speech of the natives on the Queensland plantations.

Few have recorded the speech, and in an entertaining little volume Mr. Churchill has noted all that is to be found relating to it, with some chapters by way of introduction.[1]

Mr. Churchill discusses the art of breaking English into jargon. It is delightfully simple, for "the proper way to make a foreigner understand what you would say is to use broken English." Politeness may give way to emphasis. Grammar and the elegances of speech do not matter. The want of these will not shock the native, for in no native language is it possible to be ungrammatical. In them intelligible speech consists in the placing of the vocables in the right order. Inaccurate arrangement is unintelligible nonsense. The native subjects the broken English to the rules of his own speech. As to this, Mr. Churchill, premising that a single parent for the many and diverse languages of Melanesia is as yet unproved, recognises that all the languages of that region are practically on the same plane of development, and so uses the designation "Melanesian speech" to indicate a composite of the knowledge of the languages there spoken. He regards them as isolating languages, and rejects the Malayo-Polynesian theory of Bopp, as well as the application to them of the term "agglutinative." He believes the words may be separated into monosyllabic elements, and these even may be susceptible of ultimate reduction to vowels, to which may be prefixed or suffixed a consonant with a definite power of qualifying or fixing a special meaning to the stem.

The rules of isolating speech applied to the Broken English formed the Beach-la-mar.

The vocabulary is nearly all English, and the marine element is strong. Mr. Churchill says, "There can be no hesitation in ascribing to forecastle English such exotics as *pickaninny*, *calaboose*, and *savvy*—longshore sweepings from the Spanish Main. The *squareface*, sole landward hope of the sailor, is scarcely known ashore. The sailor dialect has kept alive, and has given to these remote savages the special sense of *sing out* and *look out*, of *capsize* along with *copper*, of *slew*, of *look alive*, of *adrift* and *fashion*. Of certain elements of low, cant, vulgar English the sailors may have been the carriers." The Kanakas in the Queensland plantations enriched the vocabulary with Austral English, and to this "we must ascribe in the greater measure the inclusion of such terms as *tumble down* and *blackfellow*, of *flash* and *trash*, of *hook it* and *clear out*, of *hump* and *wire in*, of *gammon* and *bloody*." Such words as *kaikai*, food, *likelik*, little, *tambo* or *tabu* come from the island tongues, and one word, *rauss* (? clear out) is German.

Mr. Churchill has given a bibliography of the subject in fifteen entries. He has produced a most instructive and interesting book. It illustrates a simple language in the making, and records a form of speech which will disappear with colonisation and mission schools. It is to the presence of these in the Torres Straits that a decadence in jargon noted by Mr. Churchill is due.

SIDNEY H. RAY.

[1] "Beach-la-mar, the Jargon or Trade Speech of the Western Pacific." By William Churchill. Pp. 54. (Published by the Carnegie Institution of Washington, 1911.)

THE FRACTURE OF FLINT BY NATURE AND BY MAN.

AT a meeting of the Prehistoric Society of East Anglia, held at Norwich on November 4, the natural fracture of flint and its bearing on rudimentary flint implements was discussed by Mr. J. Reid-Moir.

Subjoined is a summary of the main points described:—

(1) Experiments were shown in natural percussion produced by placing a number of flint nodules in a sack and shaking them violently together. The following results were obtained:—

First, some of the flints were flaked on the edge by blows which had impinged at all angles, as would be expected from fortuitous blows.

Secondly, nearly all the blows had impinged obliquely, thereby blunting the edge and showing prominent ripple-marks.

On the other hand, human blows are always delivered at a *constant angle* to the edge of the flint, and are delivered vertically to the edge, as it is much easier to remove flakes thus than by oblique blows, which is nature's method.

Nature must of necessity detach flakes obliquely, because out of the 180 angles at which it is possible to edge-flake a flint, there is only one which gives a true vertical flake.

These vertical flakes do not show ripple marks, as the force of the blow does not pass through the body of the flint.

It was also seen that fortuitous blows produced a large number of truncated flakes on the edge of the flints, which are not seen to anything like such a large extent on human

implements, as such flaking is not required in their manufacture. With fortuitous flaking the rain of blows is practically incessant, and truncated flakes are of necessity produced.

Many of the specimens shown exhibited marked sinuous edges, but the blows which caused them were all oblique and impinged at varying angles.

(2) Experiments were performed in natural pressure by means of an ordinary and a differential screw press (with a rubber ram), giving a pressure ranging from 40 to 300 tons to the square inch.

It was found that through a thin layer of sand the pressure was incapable of fracturing the thinnest flint flakes.

On a hard surface, the pressure and resistance being equal, flakes were detached from flint nodules showing two bulbs, one at each end of the flake and opposite to each other.

In the case of a flake detached by percussion, only one bulb occurs. Therefore this fact provides an excellent test for differentiating between man's work and flaking by natural pressure.

If the under surface on which the flint rests is not sufficiently resistant, a flake detached shows only one bulb, which is entirely different from that produced by percussion.

When a suitable flint is carefully placed upon another equally suitable, and pressure applied, a "hollow-scraper" can be produced showing much finer flaking than that resulting from percussion.

It is known that the finer flaking on Neolithic implements, such as arrow-heads and "pigmies," is always produced by pressure applied by man.

A large number of specimens was shown to illustrate each experiment described.

THE MEDICAL WORK OF THE LOCAL GOVERNMENT BOARD.

THE report of the medical officer of the Local Government Board for the year 1910–11[1] has been issued with commendable promptitude. Dr. Newsholme's report, which occupies the first seventy pages of the volume, gives a comprehensive review of the public health in 1910 and of the work of the medical department of the Board, and epitomises some special subjects considered during the year, public vaccination, and the auxiliary scientific investigations carried out for the Board.

The review of the public health gives some of the more important facts as to the incidence of particular diseases, and a comparison is given graphically for the ten years 1901–10. It is gratifying to find that there has been a decline in the death-rate for all the following:—general death-rate, infant mortality, enteric fever, scarlet fever, diphtheria, puerperal diseases and accidents, and phthisis and tuberculous diseases. Measles alone has not markedly diminished. One of the most striking declines in the death-rate is that of enteric fever, which has diminished from about 16 per 100,000 in 1901 to about 4·5 in 1910, a percentage decline of 70, representing a saving of nearly 10,000 lives in 1910 compared with 1901, and a financial saving estimated at 1,492,800*l.* Pulmonary tuberculosis (phthisis, consumption) was responsible for 38,639 deaths in 1909, still a heavy mortality; but had the same death-rate existed in this year as in 1871–80 the deaths would have been 78,308: this saving of life represents a financial saving of nearly *six millions* sterling. Preventive medicine may well be proud of such results as these!

The circumstances of the outbreak of plague in Suffolk are discussed, but these have already been dealt with in our pages.

Of the auxiliary scientific investigations, Dr. Gordon has once more studied the types of streptococci present in the fauces in scarlet fever. He has found that the scarlatinal streptococci are indistinguishable from streptococci present in other disease processes; this leaves the problem of the etiology of scarlet fever still unsolved. Infantile diarrhœa has been investigated by Dr. C. J. Lewis at Birmingham, Dr. S. M. Ross at Manchester, Dr. R. A. O'Brien at London, and Dr. T. Orr at Shrewsbury. Of diarrhœa cases, 49·2 per cent. yield non-lactose fermenting organisms from the fæces; of non-diarrhœa cases, only 19·1 yield similar organisms, showing a much greater frequency of non-lactose fermenters in diarrhœa than in health. No one type of organism, however, has been found with sufficient frequency to justify the assumption that the disease is necessarily or usually attributable to one and the same organism.

Dr. Andrewes contributes a study of the bacteria present in the air of sewers and drains, a subject previously investigated by him for the Board in 1906–8. In the case of sewers, the dissociation of micro-organisms from the sewage is very small. In the case of drains, where there may be much more splashing than in sewers, organisms dissociated from the sewage may be far more numerous and may be carried by air currents in large numbers for considerable distances.

Dr. Inman has studied the secondary infections in pulmonary tuberculosis. He considers that in nearly every case of "open tuberculosis" of the lungs the tubercle bacillus is the predominant infecting agent.

R. T. HEWLETT.

[1] Fortieth Annual Report of the Local Government Board, 1910–11 Supplement containing the Report of the Medical Officer for 1910–11.

THE HEDLEY GOLD FIELD, BRITISH COLUMBIA.[1]

THE mining town of Hedley on the Similkameen River, in British Columbia, a little west of the 120th meridian and about twenty miles north of the United States boundary, is the most important mining camp in that district, and is of interest owing to the unusual character of its ores. The town is situated near the mouth of the Twenty Mile Creek, a canyon from 2500 to 4000 feet deep and with walls sloping at angles of 40°. The first mining claims were discovered there in 1894, and though many small mineral deposits have been found in the district, there are only two producing mines, the Nickel Plate and the Sunnyside Mines, of which the former is the most productive gold mine in Canada.

The country consists of Upper Palæozoic rocks, doubtfully identified as Carboniferous; they include a lower series of limestones, quartzites, and argillites, a middle series of limestones and quartzites—the Nickle Plate Formation and an upper series of tuffs and volcanic breccias—the Red Mountain Formation. The sedimentary series was invaded in early Mesozoic times by intrusions of gabbro and diorite. The ore deposits are unique in America, for they are contact metamorphic deposits containing arsenopyrite as the principal gold-bearing mineral. The ores are developed along the contacts between the gabbro and diorite with the sedimentary deposits. The igneous rocks have metamorphosed the limestones, but have had a comparatively small effect on the quartzites, argillites, and tuffs. The mineralisation is greatest where the contact alteration is greatest, and though gold is found in all the sulphides the highest values occur in the arsenopyrite. The granodiorite has had comparatively little effect either as a source of metamorphism or of ores, and the gabbro has been far more active than the diorite. The gabbro forms the foot-wall or is closely associated with the ore bodies in the two producing mines and in some of the smaller ore deposits.

After the intrusion of the igneous rocks the field was faulted and fissured; but neither faults nor fissures are of much economic importance. The faults were later in date than the ore bodies, and the fissures are filled with barren veins of quartz and calcite, and contain no ore deposits of commercial value. The ores, in fact, do not occur in well-defined lodes, but they grade off imperceptibly into barren country rock. As the ore deposits occur parallel to the bedding planes, it has been suggested that the gold was originally scattered through the sedimentary rock, and has been concentrated by the igneous activity; this suggestion was all the more natural, as the gold has been found widely distributed through the sedimentary rocks. It is found in them, however, only within the sphere of influence of the

[1] "The Geology and Ore Deposits of Hedley Mining District, British Columbia." By C. Camsell. Canada Department of Mines Geological Survey Branch, Memoir No. 2. Pp. 218+xx plates+8 figs+4 maps. (Ottawa, 1910.)

igneous rocks. Mr. Camsell rejects the hypothesis of the sedimentary origin of the gold, since no ore bodies have been found in any rocks except those that have been metamorphosed by the diorite-gabbro intrusions.

Mr. Camsell's description makes it quite clear that the ores are of metamorphic origin, and were due to the action of mineralising solutions given off from the intrusions. The gold has certainly not in this case come up from deep-seated fissures independent of the igneous rocks. The disturbance of the original arrangement of the ores by secondary enrichment is of comparatively secondary importance; the enrichments, as is so often the case, are best developed where some impermeable layer has prevented the further movement of descending solutions.

The memoir is illustrated by a series of excellent maps, sections, and photographs. A few lines on p. 178 are unintelligible, apparently through an accident in setting the type.

J. W. G.

BEIT MEMORIAL FELLOWSHIPS FOR MEDICAL RESEARCH.

THE trustees of the Beit Memorial Fellowships for Medical Research elected the following persons to fellowships on December 16. In each case we give the general character of the proposed research, and the institution in which it is proposed to carry out the research.

Dr. P. G. E. Bayon.—Investigation on the streptothrix stages of various acid-fast germs. Differentiation and classification of the acid-fast group of germs, with special reference to leprosy and tuberculosis. Treatment and diagnosis of leprosy on specific lines. At the Lister Institute, and, if possible, at a leper camp in India or Robben Island.

Evelyn Ashley Cooper.—An investigation of the protective and curative properties of selected foodstuffs and other substances and of their ingredients against beri-beri (polyneuritis); of the nature of their active constituents; and of the value of the foregoing in the treatment of forms of neuritis induced by conditions other than those predisposing to beri-beri. At the Lister Institute of Preventive Medicine, Chelsea.

Elizabeth Thomson Frazer.—An inquiry into the value of the complement fixation test in tuberculosis as a guide to diagnosis and treatment. At the Bacteriological Laboratory, Pathological Institute, Royal Infirmary, Glasgow.

George Graham.—Investigations on metabolism in health and disease, especially in relation to the retention of nitrogen in kidney disease. At the Pathological Laboratory, St. Bartholomew's Hospital; the laboratories of the II. Medizinische Klinik Krankenhaus, München, Bavaria, Germany.

Dr. James Andrew Gunn.—Research in pharmacology and experimental therapeutics:—(1) the toxicity and trypanocidal action of arsen-lecethid; (2) further investigation of the action of harmaline on the uterus, with the view of determining its possible value as a substitute for, or adjuvant to, ergot; (3) natural immunity to certain glucosides; (4) an investigation of certain pharmacological and toxicological group-actions. At the Pharmacology Laboratory, University College, London.

Dr. Willoughby Henwood Harvey.—Pathological conditions of the kidney brought about by certain products of putrefaction which are produced in the alimentary canal ("Autointoxication and Experimental Nephritis in Rabbits," *Journ. of Path. and Bacteriol.*, 1911, vol. xvi.). The precise nature and conditions under which certain pathological changes are produced in the kidneys by large doses of urea, and the effect of certain purine derivatives, particularly caffeine. At the Pharmacological Laboratory, Cambridge.

Judah Leon Jona.—The toxæmias attendant on pregnancy and childbirth. At the Lister Institute of Preventive Medicine.

Rowland Victor Norris.—An investigation into the formation and metabolism of glycogen in the organism, and its bearing on diabetes and other pathological conditions. At the Lister Institute of Preventive Medicine.

Charles Henry O'Donoghue.—The relation of the œstrus cycle to the functional activity of the mammary glands, and generally to investigate the development, morphology, and physiology of the mammary apparatus in the mammalian series. At (1) the Zoological Laboratory, University College, London; (2) the Institute of Physiology, University College, London.

Charles Claud Twort.—The immunity reactions in Johne's disease of cattle (pseudo-tuberculous enteritis), and their relation to leprosy and to human, bovine, and avian tuberculosis. At the Brown Institution.

TECHNICAL INSTITUTE PROBLEMS.[1]

THIS institute now coordinates all the teaching that used to take place in many small science classes in the city. You have a costly and magnificent building with many thousands of evening students and a few day students, and it is important to know whether you are doing with it all that may be done. All technical colleges in the country have much the same history and are trying to solve the same problems. I do not know what the salaries are here, but the curse of all other science colleges known to me is that the salaries are only half what they ought to be, and there ought to be more professors and teachers. A city puts up a magnificent building with well-arranged laboratories full of expensive apparatus, and it economises in the most important item—the teacher. As the Americans say, an expensive gun is all right, but what of the man behind the gun?

I shall speak particularly of the needs of the engineering trades, but what I say applies to nearly all the manufacturing trades of the town.

A boy at fifteen fit to be an apprentice ought to be fond of reading English books, to be able to write an account of things he has seen and done, to be able to do simple computation such as easy mensuration, to do a little mechanical drawing, and he ought to know something of natural science. Such an apprentice begins to learn and begins to be useful in his trade from the first day; he is sure to attend evening classes in this institute, and he will at the age of twenty-one have had a very fine training. But 98 per cent. of apprentices knew little when they left school at thirteen; they have had time to forget that little, and they know almost nothing when they enter the factory. Therefore for nearly two years in the factory they are mere message boys; they have no inclination to go to evening classes, and if they had, or if their masters were to insist on such attendance, they would benefit very little.

It is very easy to blame the masters, but I tell you that the average apprentice has been ruined already; it is scarcely worth while trying to teach him anything.

In spite of their ignorance, these apprentices in the past acquired a manual skill which is the wonder of foreigners. But much of that skill is now comparatively useless. The machine tool-shop has become far more important than it used to be, and labour-saving tools have greatly displaced handicraft; head work has become far more important, and if a man is not to be a mere tool-minder he must know something of the sciences which underlie his trade. It is also important that he should be happy through interest in his work, else he will develop into a mere labour-saving tool himself, without imagination and without initiative—a poor sort of citizen. Again, reforms in workshop methods and invention depend greatly upon the ideas of the workmen, which gradually reach their superiors.

There is, however, no need to impress upon you the necessity for evening science classes. You have them here. But see what a great waste there is! This costly building, its well-equipped laboratories and well-trained staff of teachers, are devoted during the first two years of a boy's life here to teaching him the things that he ought to have learnt at his primary school or in some continuation school. I may tell you that in Scotland and the north of England a great effort has been made in the last ten years to capture the boy of thirteen. In Scotland it is compulsory that he should attend continuation-school classes in the evening, and it is going to be made compulsory also in England. In Scotland, however, it is being recognised that the

[1] From an address delivered at the opening of the new engineering laboratories of the Municipal Technical Institute, Belfast, on November 24, by Prof. John Perry, F.R.S.

ordinary primary-school master can only teach these boys as he has taught them already, and special kinds of instruction are being given in many places which really fit the boy of fifteen for science class work.

I knew, as others did, about this great college of yours, and I wondered where you would find apprentices here who were fit to take these evening classes. But I have made a discovery. You here are actually taking boys of thirteen in the day time and giving them just that kind of instruction which will fit them perfectly for their work; and these boys when apprentices will, I hope, come to your evening classes. This is a temporary expedient, forced upon you, for it is a pity to devote your space to such elementary work; but it is very important that this example should be set. Four years ago I found that the Hull Institute had this system. A boy who is from twelve to thirteen years of age, and has perhaps passed the sixth standard, may attend the institute in the day time until he is fifteen years of age. He does some freehand drawing, practical plane and solid geometry, and mechanical drawing; there is what is called a mathematical laboratory; I pay the mechanical laboratory work a high compliment when I say that it is there as well done as it is here; there is laboratory work in heat, electricity, and chemistry. The results are very wonderful. I had to use a high standard when I asked the boys questions. They could write an account of the work they were doing in decent English; their reasoning powers were evidently well developed; they had power to use elementary algebra and trigonometry in new problems. I could not imagine a better training for boys who intended to enter the shipbuilding and mechanical and electrical and other engineering works of Hull. I am glad to think that you are doing this also in Belfast.

Just as in Scotland, this problem of the ignorant apprentice has been attacked in the north of England during the last six years by means of continuation schools, and many important institutes are now able to fill their spaces in the evening with boys of fifteen who have already passed the kind of standard presented by what is called the Lancashire and Cheshire Union. It results that later, in the six years from fifteen to twenty-one, there are numerous students who are acquiring a scientific and practical knowledge of engineering which is much superior to what is obtainable in the best American and German science colleges of university rank. I say superior, because these British boys are not only being given a practical knowledge of higher mathematics and of science, and not only is there more common sense in our use of laboratories, but these boys become skilled in their trades because they learn their trades in real workshops working side by side with real workmen, doing work which has to be paid for.

If you want to know how much can be done in evening classes, I advise you to visit the great Glasgow Science College or the Heriot-Watt College at Edinburgh, which have also large day classes. Graduates of the universities in engineering come to the evening classes of these colleges to get post-graduate instruction, and yet these colleges cannot themselves confer degrees. The great success of these evening classes is due to the dogged persistence of the Scotch people in introducing common sense into their primary-school teaching and in coordinating it with the science-class teaching.

You have seen these laboratories, but it is possible that many of you do not quite understand what an important work they are doing. In secondary schools and colleges we used to teach only 5 per cent. of our students, those who were capable of abstract reasoning, and we called them the clever students. We called the others stupid until they thought themselves stupid, and we did not recognise the fact that these others were in many cases very much the cleverer. They refused to reason about things they did not understand—that they were not familiar with. And so their honest minds refused to follow their teachers in geometry and other parts of mathematics; they refused the study of what is often called natural science in schools. Yes, and in spite of the mental training which is always bragged about by Latin masters and other teachers of philology and grammar, the average boy was stupefied by all the scholastic work he did, and if it had not been for their sports, their teaching of themselves by observation and experiment out of school, we should have stupefied them for their lives.

I have always felt that my best work was in teaching that average student whom most teachers call stupid, but whom I regard as the most earnest and hard-working and honest, and altogether best of all students. And now in every university, in every polytechnic of Germany or science college of America, there are great laboratories, and in most of them the average student still has no chance. Teachers will not exercise their common sense. Why, a man can train a monkey or a dog or a bear because he studies the animal; he never studies the average boy, whose mental powers are infinitely greater: he calls him stupid.

In mechanics we deal with mere matter and its motion. The fundamental ideas of time, length, area, volume, weight, force, velocity, &c., are quite familiar to all boys, and yet the average boy cannot be taught the simplest combinations of these ideas, such as momentum. And the stupefied boy, who is to become a mechanical engineer, is now placed in an engineering laboratory, where the experiments are simple enough, but they give him no new ideas; and because the big testing machines, which are perfectly easy to understand, cannot be seen anywhere else, he is said to have had a complete laboratory training.

If things are bad in mechanics, think of the training of an electrical engineer! Of course, an electrical engineer must first and foremost be a good mechanical engineer, but he must also know about the laws of electricity. Well, he is placed among the most delicate apparatus used in testing, consisting of reflecting galvanometers and resistance coils and Wheatstone bridges, and he does a lot of exercises and passes an examination, and after two years' work he knows absolutely nothing of the simple principles of electricity; his mind is in a state of confusion on the whole subject.

Now before teaching geometry you ought to make a boy familiar with geometrical notions by his own drawing and measurement and computation, and so you ought to familiarise a boy with notions of current and electromotive force and resistance by letting him play and measure with the simplest kinds of electrical apparatus. For these things are really abstract notions, and they cannot be comprehended at all easily by the average boy.

If you ask a boy "What is force?" and he gives you the answer, "Force is the rate of change of that vector which we call momentum," you must give him full marks. If you ask "What is Ohm's law?" and he answers "Current is electromotive force divided by resistance," again you must give him full marks. And yet it is years before the engineer knows thoroughly well what these words mean, and many a student who takes prizes never gets to know what these words mean.

Now all through the laboratory work here you will see that there is an effort to make a student really understand the few fundamental principles which underlie all engineering work. These principles are few and simple-looking; but if a man knows them thoroughly well, as well, for example, as he knows his way about his own house in the dark, then there is scarcely any new problem, however complex, in his engineering work that he cannot solve; and it is only the student who has fiddled with simple electrical apparatus, making simple measurements and experiments, who can understand how to use your delicate testing apparatus or electric generators and motors. If the fundamental principles are part of his mental machinery he will have no difficulty in comprehending the most difficult things.

Although we speak of our ways of teaching as "practical geometry," "practical mechanics," "practical electricity," &c., you must not get the idea that these are degraded subjects. Academic people had the names "geometry," "mechanics," &c., for subjects taught in the old way; our subjects are the old subjects taught in a new way, and it has been abundantly proved already that the new way is the only way by which the average student can learn at all; and not only this, but it is the very best way for all students. Almost no student, however great he may be as a mathematician, taught in the old way, has a real knowledge of mechanics; force and momentum are always abstractions to him; mental phenomena are his only study.

mere logical deductions from a few simple premises which, for all he knows, may be quite wrong.

Academic methods of teaching mathematics have quite failed with the average student, whereas the system which is called practical mathematics has proved most successful, not only with him, but for men who are capable of becoming great mathematicians. The average student now gets a thoroughly good working power over what are usually called higher mathematical methods; he can use his knowledge readily in all kinds of practical problems. It used to be that when an evening mathematics class was started in September only about one-third of the students were in attendance in December, and when May came round there might be only one or two students in the class. Now the attendance keeps up to the end of the session, and there is scarcely any subject in which the students show so much interest. Their eyes and faces are bright, they work hard, and they evidently enjoy the work. We have merely introduced some common sense into the teaching; we have approached the student's mind from another point of view than the old academic one, from the only side on which he has ever been taught anything—the side of observation and trial. We educate his reasoning powers through concrete examples until he gets a firm grasp of abstract truths. There is nothing really new in what we are doing; it was insisted on by Milton, by Herbert Spencer, and by many another philosopher. The authorities of this institute were among the first to adopt this method of teaching.

I praise all these things which your institute is doing, and I think that my praise is of value, because I am specially competent to speak of these things. Many of you understand better than I do the value of the textile and other trade classes, but we all feel that the work that is being done in them is valuable work.

I wish I had time to speak about it, but I am neglecting a great deal in this address. For example, I am saying nothing about some exceedingly important research in engineering science that is going on in this institute which is adding to our knowledge of the strength and trustworthiness of materials and other things.

I said in opening the advanced laboratories to-night that there was a scientific educational thread of thought running through the whole scheme of Prof. Smith. Before he enters that laboratory a student must be prepared for this higher work by work in the other laboratories. Every unit to be experimented upon is small; that is, it is not a huge thing that scares the student; a group of three or four students can take charge of the work; and it is not so small but what the results of experiments shall be of practical value. The actions of steam engines, steam turbines, gas engines, oil engines, petrol engines, electrical generators, various pumps and water turbines, refrigerators, and many other things, can be fully investigated through actual measurement of their performance in all sorts of circumstances. It is almost the best laboratory of its kind that I have ever seen.

As I am speaking of the evening work in particular, what I say is that few boys at the age of fifteen are fit to be apprentices in any kind of engineering in Belfast; but if a boy is fit he will certainly attend these classes in the evening, and in the day time if he is allowed. If he attends two or three nights, and perhaps half a day twice in the week, until he is twenty, then I say that he has had a finer engineering training than he could have had as a rich man's son in Germany or America or anywhere else.

I know the breed well; I get fifteen or twenty of them every year who have scholarships to maintain them in London. They know all that is in the text-books before they come. Four or five of them come from the Government dockyards, where they have attended excellent science classes and have been five or six years in the workshops, and the rest are all good workmen too.

But Belfast men of this type ought not to have to go to London or Dublin to complete their scientific education. They ought to be able to do this in Belfast in attending the day classes of this very college. Why, even two years of the highest kind of instruction here would fit men like National Scholars for the best posts. I need not tell you, however, that even then they shall only have entered on the race for the highest posts; much experience of men and things, and a foundation of character, a developed imagination and general culture, and much else go to the making of the great engineer.

This evening work is now the most important work of your institute, and if you can only improve the character of your students at fifteen or sixteen the work will become infinitely more important; but surely this costly institution is not going to neglect the work that is more important still—its work during the day.

Do you know why those clever experienced National Scholars and others of which I spoke just now—do you know why they come to us in London? It is because the Royal College of Science is the only college of high rank in Great Britain where these men can pursue their studies. If they can write a decent letter; if they can write in fair English an account of anything they have done or seen, that is enough to secure admission. We give them chances of learning French or German free of cost, but they can get the highest honours which the college has to give without a knowledge of these languages.

There is not one college of university rank in Great Britain which these students can enter unless for a time they cease the studies they love, to work up Latin and French or German merely for the purpose of passing a matriculation examination. Now just as there are great classical scholars who cannot comprehend Euclid, so many of the men who most incline to the study of natural science hate Latin and Greek, and, indeed, all other languages than their own, and the study of these languages ought not to be forced upon them.

Your college here ought to give the highest kind of instruction in the day time to all kinds of engineers; Belfast needs such a science college, and you ought to aim at getting three or four hundred of fit students every year. This college ought to be, and will, I hope, become the great engineering school of the Queen's University of Belfast, and every day or evening student who is made fit to be an engineer ought to receive a university degree.

In a university there are always many schools, and every student ought to pass an entrance examination. Now I wish to direct attention to the fact that the authorities of modern universities have forgotten the object of an entrance examination. It is simply to test whether a man is likely to benefit by any of the courses of study. Four hundred years ago all lectures were in Latin, all books were in Latin; unless a man knew Latin he could not benefit by any of the courses of study, and it was right to reject him; there was a commendable custom at some Oxford colleges that if a student spoke one word of any other language he was fined. Then at the Renaissance Greek was made obligatory, and geometry for students who had to follow certain courses of study.

And now, when all lectures are in English, when our English literature is greater (if we include translations) than any other literature that has ever been, we still make a knowledge of Latin and Greek compulsory.

The Queen's University of Belfast is intended for the education of men who intend to enter professions connected with politics, divinity, law, education, medicine and surgery, economics, literature, and engineering. In almost all cases a knowledge of Latin, and in many cases a knowledge of Greek or of one or more modern languages, and above all a university degree, are essential for professional qualification.

No one, therefore, can object to obligatory Latin and other philological subjects being required from the greater number of the existing students of Queen's University, which has been so eminently successful in preparing men for some of the above professions. It has been so successful that people forget that the general higher education of the community is being altogether neglected, the general culture of professional men is being neglected; and in the case of professions involving applications of physical science, the numerous branches of engineering, useless obligatory subjects are insisted upon, so that for these professions the university is a harmful institution.

Medical students have so much hard work in various kinds of grammar subjects required for matriculation that they must be forgiven for their utter ignorance of all things in natural science. But an outside Philistine may also be

forgiven when he suggests that the whole country might benefit if the school training of medical students put them more in sympathy with scientific discovery. It is a well-known fact that there are medical men in lucrative practice, said to have the highest university qualifications, who tell you frankly that they do not believe in bacteriology.

The greatest of your professional men passed through school and entered college with the smallest possible acquaintance with natural science; their university course involved very little study of natural science; that course was so narrow that, although we hear such men talk of their love for literature they take no pleasure in reading Shakespeare or Jane Austen or Goldsmith or Dickens, and they take no interest in those applications of science which are transforming the world. Now I consider with Sir Norman Lockyer that the study of natural science is as important a line of defence of the British Empire as our Army and Navy.

And yet all the most expensively educated clever men are ignorant of natural science. In several papers and speeches.[2] I have pointed out the great loss which the country feels on account of this and the absence of breadth of culture and mental power which are due to it. However harmful the present university standard may be to clever men, it is even worse for the average man, because all our secondary schools train boys as if they were going to a classical university. The average boy represents more than 90 per cent. of all the boys in the higher schools. I say that he is capable of the highest kind of training; you may make him fond of books, and he will then educate himself until he dies. You can put him in the way of being fond of English literature, of writing good English; of easy computation; of recognising the significance of scientific discovery; of being proud of himself; of having confidence in his reasoning powers. He will not then readily let his emotions be played upon by an eloquent foolish speaker, and he will not easily be deceived by a quack of any kind. You can make him a well-educated man, fit to be a citizen of Belfast, to take scientific charge of a business that he likes; but, once for all, understand that it is not through Latin or Greek or academic mathematics that you will develop his mental powers.

At present Latin is the curse of his young life. He spends two or three years on Euclid or on a wretched thing that has taken the place of Euclid; you do not try to make him familiar with geometrical ideas, and yet you think he will learn to reason about them. You try to teach him everything through books, through words, although you know that since he was an infant he learnt everything that he did learn through experiment and observation. Whatever is likely to be unessential to him in life you teach him laboriously; he gradually takes in as much as enables him to pass examinations, and then he quickly forgets it all. No part of his school work has been a pleasure to him. You know all this, but you say that his mind is trained, although he may forget his school work. Well, it is not of much use, but I will say to you that you have not trained his mind. Whatever you have done has been to enslave and degrade the boy's mind. You have made him believe himself to be stupid. He did get training from his friends, from play; and he and his companions will go on educating each other through their sports, as puppies do. But how different his life would be if you let him teach himself through his own scientific experiments. At the age of twenty-one he dislikes books; he reads no newspapers; even the sporting news he would prefer to hear by word of mouth. He cannot write his own language—the language of his mother, his wife that is to be, his enemies and friends. The first chance of real literary education he has is when he falls in love, and he has to be careful of his spelling and grammar when he writes love-letters. Then it is that he finds himself with too small a vocabulary. Read the evidence of Lord Roberts before the War Commission; without that it is scarcely possible that you can believe that nineteen-twentieths of our public-school boys should be so illiterate as they are. They are ignorant of everything that is essential to their life except what they learned outside the class-room. But they speak the truth; they have a sense of personal honour; they scorn meanness. They often become what is called good men of business if they are well-to-do, and they manage businesses and estates on old-established lines well enough; but alas for them if the businesses which they manage are changing their character! All businesses are getting to be conducted now more and more on scientific lines; scientific management means success, and unscientific management means failure in nearly all businesses nowadays, and most public-school boys are so spoiled that they cannot be trained. I can speak particularly of manufactures which are applications of physical science. If such a boy is pitchforked into works he learns nothing. If he enters a technical college like this he has no knowledge, no habit of thought on which it is possible to build.

I have been during my life several times all over the globe, and wherever I have gone I have found numbers of average English public-school boys who were fitted by their training for no job but that of a hewer of wood and a drawer of water; children of Gibeon they are, and so they must remain. The last time I was in Winnipeg I had strong evidence of the poor reputation of the numerous gentlemanly young Englishmen who were trying to make a living in Canada and the United States; whereas the sons of poor parents coming from schools where they were taught only English subjects and how to compute were thought to be starting on brilliant careers.

There is an enormous number of young engineers whose fathers paid great premiums for them on their entering works, and they cannot get work to do or they are glad to get the wages of a common fitter. Perhaps they have picked up sufficient knowledge to be able to look after engines and electrical machines, but their knowledge is very superficial; their labour is really unskilled, and small changes in the character of the work they are asked to do find them incapable. They are always talking of themselves as victims of competition, of an overstocked profession. And yet they cannot help seeing numerous men who were once poor, men who were compelled to earn wages since they were fourteen years of age, occupying high positions; men whose school training did not unfit them for entering a college such as this, and for obtaining the most advanced knowledge of the theory and practice of their profession.

If school education were taken out of the hands of the pedants, the average boy might have a delightful school life.

The Belfast well-to-do business man knows instinctively that his secondary schools are all wrong, and, as a rule, he takes his boy away from school at fifteen and he puts him in business. In this way he avoids a great many of the evils of the public-school life—the stupefying school work, and the self-protective rush of the boys to sports, to loafing, and the minor vices.

Training in natural science, laboratory work in drawing and in computation, is the very best method of development of the reasoning faculties. It is good for the boy who is called clever; it is the only possible method for the average boy. The civil engineer has but little theory; he needs but little knowledge of mathematics; but of all men he ought to be most intimately acquainted with the fundamental principles of science. He has few formulæ or fixed rules; judgment and experience enable him to see his way to the solution of problems of great complexity, so that he needs to have his reasoning powers developed more even than the electrical or mechanical engineer, who has very definite rules to guide him in his professional work.

A great day science college in Belfast would give just the training that Belfast business men desire. By means of it their businesses would be conducted more and more on scientific lines.

Well, you can have such a college. In London, in the colleges of the City Guilds, at the Royal College of Science, in several of the polytechnics, there is no difficulty in filling the class-rooms in the daytime. In Glasgow and other cities there are great science colleges where again there is less and less difficulty found in filling the class-rooms in the daytime with students who are fit for the work.

There is no city of the size of Belfast in Germany or America where there is not a great science college which is filled with students doing the highest kind of engineering work and other science work in the day time; and here

[2] See, for example, "England's Neglect of Science" (NATURE, July 5, 1900) and an address delivered at Oxford (NATURE, December 31, 1903).

you have the college, but where are the day students? You are blinding your eyes to facts: you have no boys in Belfast who are prepared for modern business life in your schools; you have no boys fit to begin study at this college. The sooner you set about such a kind of school work as is necessary the better.

I do not know what the Model School is like now, but fifty years ago it produced better boys of the kind that you now want than any school in the world.

If you would sink your pride, and as a temporary measure take here in the day time boys of fourteen and teach them until they were seventeen, showing Ulster how good modern-school teaching might be given, I feel sure that you would make a rapid success. But such school work ought to last only until your example would be followed by outside schools. It strikes me, in fact, that you ought to show both the primary and the continuation and the secondary schools what they ought to do.

There are now quite a number of secondary schools in England and Scotland which provide science colleges with just such intelligent students as they want. Our unscientific rulers have given an Intermediate Board to Ireland which takes care that there shall be no such schools here. Nearly all the great English public schools have made a vigorous attempt to give the kind of education which is needed, but unfortunately the movement languished because it is opposed to all the traditions of such schools, and there are things like Latin which no schoolmaster will part with. This is the reason why the modern sides of the English public schools are such failures.

Your difficulty here is felt in many other places, but in some other places it has been grappled with and conquered.

I repeat, it is in your power to make this the great science school of the University, not merely developing applied science, but developing scientific discovery in both physical and biological science; but your schools do not yet prepare boys for such studies.

At present the Queen's University of Belfast refuses to recognise your students unless they pass entrance examinations in Latin and French or Latin and German. The time is coming when you yourselves will be able to confer a science degree on your cleverest students, the students who have had sufficient self-respect to neglect subjects which for them were not educational.

MOMENTUM IN EVOLUTION.[1]

It is a fact well known to palæontologists that many widely separated groups of the animal kingdom have, during the course of their evolution, and especially towards the end of that course, shown a strongly marked tendency to enormous increase in size.[2] We see this in the extinct eurypterids, giants amongst the arthropoda, in the huge labyrinthodont amphibians, in many reptiles of the Secondary period, some of which attained a length of 180 feet or more, and amongst mammals in the extinct Tinoceras and the still surviving elephants and whales.

Comparative anatomists are familiar with similar phenomena exhibited by individual organs, such as the extraordinary development of horns and spines on many of the extinct reptiles referred to, the gigantic and grotesque beak and helmet of the hornbill, and the tusks of Babirusa.[3]

The exuberant development of some organs of this kind may possibly be attributed to the action of sexual selection, and, indeed, our daily experience of our own species seems to warrant us in believing that there is no limit to the grotesque results which may ensue from the unrestricted exercise of the æsthetic faculties by either sex; but it scarcely seems reasonable to attempt to explain all such bizarre and monstrous productions in this manner.

In all the cases cited, and in many others which could be adduced, either the entire body or some particular organ appears to have acquired some sort of momentum by virtue of which it continues to grow far beyond the limits of utility, although perhaps in some cases a new use may be found which will assist the species in maintaining itself in the struggle for existence. An enormous increase of mere bodily size, however, seems in the long run to be always fatal to the race, the place of which will be taken by smaller and presumably more active forms. The gigantic amphibians are all extinct, so are all the really gigantic reptiles; and of the gigantic mammals only a couple of species of elephants and a few whales survive, all of which are being rapidly exterminated in competition with man.

Is there any justification in recent developments of biological science for the belief that a race of animals may acquire a momentum of the kind referred to which may ultimately lead it to destruction? Is there some brake normally applied to the growth of organisms and organs, and, if so, are there occasions on which the brake may be removed, leaving the organism to rush to destruction like a car running away downhill? I hope to be able to show some ground for believing that both these questions may be answered in the affirmative.

It is, I think, now generally accepted by physiologists that the growth of the different parts of the animal body is controlled by internal secretions or hormones, the products of various glands. Thus we know that disease of the pituitary body in man leads to acromegaly, one of the symptoms of which is great enlargement of certain parts. The most dreadful of all diseases to which human beings are liable, cancer, is essentially due to an unrestrained multiplication of cells, and consequent abnormal growth of tissue, which may very possibly be correlated with the extent to which some specific controlling secretion is produced in the body. In short, we are justified in believing that, in the individual, growth is normally inhibited or checked by specific secretions, and that in the absence of these it will continue far beyond the ordinary limits.

The question next arises, Can we apply this principle to the race as well as to the individual? I see no reason why we should not do so, and, paradoxical as it may seem, I think we may be able to explain the growth of the organism as a whole, and of its various organs, beyond the limits of utility, as an indirect result of natural selection.

When a useful organ, such as the tusk of a wild boar, is first beginning to develop, or to take on some new function for the execution of which an increase in size will be advantageous, natural selection will favour those individuals in which it grows most rapidly and attains the largest size in the individual lifetime. If growth is normally checked and controlled by some specific secretion, natural selection will favour those individuals in which the glands which produce this secretion are least developed, or at any rate least active. This process being repeated from generation to generation, these glands (whatever may be their nature, and we may use the term gland for any cell or group of cells which produces a specific secretion, whether recognisable as a distinct organ or not) may ultimately be eliminated, or at any rate cease altogether to produce the particular hormone in question. Moreover, this elimination may take place long before the organ the growth of which is being favoured by natural selection has reached the optimum size. When it has reached this optimum it is certainly desirable that it should grow no larger; but there is no longer any means by which the growth can be checked: the inhibiting hormone is no longer produced, the brake has been removed, and further growth will take place, irrespective of utility, until, when the size of the organ gets too great to be compatible with the well-being of the individual, natural selection again steps in and eliminates the race. The same argument, of course, applies to the size of the body as a whole, as well as to that of its constituent organs. Is it not possible that, the normal checks to growth, being thus removed along certain lines by the action of natural selection, a definite direction may be given to the course of evolution which the organism will continue to follow, irrespective of natural selection?

I shall probably be told that all organs vary, and that when any particular organ has reached the optimum size

[1] Paper read before the Section of Zoology of the British Association at the Portsmouth meeting by Prof. Arthur Denny, F.R.S.

[2] *Vide* Dr. Smith Woodward's presidential address to the Geological Section of the British Association, 1909.

[3] Darwin supposed that these tusks, which are curved backwards in such a position as to render them useless as weapons of offence, might still be defensive and used to parry blows, but this scarcely seems sufficient explanation of their enormous development.

natural selection will prevent it from going further by eliminating the unfavourable variations, i.e. those which exhibit further increase. It may be admitted that the organ in question will probably exhibit variation in size after reaching the optimum due to differences in nutrition and other peculiarities of the individual environment; but I fail to see how, in the absence of the gland which produces the specific controlling secretion, and which we have assumed to have been already eliminated, there are likely to be any variations of a minus character suitable for natural selection to work upon. In other words, it appears to me probable that natural selection, having once let go her control of growth, would be unable to regain it. In order that she might do so, it would be necessary either that the glandular organ which originally produced the inhibiting hormone should be again developed or that some other organ should take its place. It is, however, generally admitted that an organ, once lost, is never redeveloped, and it does not seem likely that any other glandular organ, which we may suppose to be already occupied in producing a specific secretion for some other purpose, would be able to take on new duties and provide the necessary control before it was too late to save the organism from destruction.

If there is a possibility of any cumulative effect from generation to generation there seems no reason why, in these circumstances, increase of size should not continue indefinitely until it becomes incompatible with existence. Have we any right to assume any such cumulative effect? I think we have, for we know very well that the whole ontogeny of any one of the higher animals is nothing but the accumulation of a number of successive stages which have been added one after the other in the individual lifetimes of past generations. This, at any rate, is the teaching of the recapitulation hypothesis, in the truth of which I, for one, am a convinced believer. We also know from the facts of embryology that as each successive stage is added there is a tendency both towards an increase in the length of time occupied in development and also towards compression and abbreviation of the earlier stages, so as to make room for new chapters of the record.

It seems, therefore, not unreasonable to assume that any increment in size which is gained by an individual animal or one of its organs before the period of reproduction, or before the germ cells which will give rise to the next generation are matured, and which is the result of the removal of some controlling factor, will tend to be inherited in the offspring in a cumulative fashion. If not, why have other features in the ancestral history been accumulated by heredity? It may be said that after the maximum rate of growth has once been attained there will be no further increase in the size of the organ; but I think there will, if only because there will be a slightly increased time available, owing to the lengthening of the period of development in which growth may take place. Then, even if there is no further acceleration of the actual rate of growth after the controlling influence has once been completely removed, the lengthening life-history will still afford opportunities for increase of size. It seems not impossible, however, that acceleration might also continue in connection with the shortening up of the stages of development in the ontogeny.

I should like to meet in advance another objection which may be raised to the views herein advocated. It may be urged that many of the bizarre and almost monstrous characters under discussion, such, for example, as some of the excrescences of the dermal armature in extinct reptiles, can never have had any value as adaptations, and that therefore natural selection could never have encouraged them to increase so much in size as to get beyond her control. Here, however, the principle of correlation comes in. Just as many different parts of the body are affected by disease of the pituitary gland, so the removal of the gland which controlled the development of some undoubtedly useful organ, such as a frontal horn, might at the same time permit the growth of all sorts of excrescences which have no adaptive significance.

I need hardly say that I have no wish to speak dogmatically with regard to the cause of that remarkable momentum which organisms certainly seem in many cases to acquire during the course of their evolution. Our knowledge of internal secretions and their specific action upon the different parts of the body is still in its infancy; indeed, it has hardly commenced; but I venture to point out to biologists a possible clue to what has been for a long time an insoluble enigma. I hope that my suggestion will be freely criticised, and that it may give rise to a discussion from which some grain of truth will ultimately emerge.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LORD HALDANE has been elected Chancellor of the University of Bristol, in succession to the late Mr. Henry Overton Wills.

THE Clothworkers' Company has supplemented its previous grant of 500*l*. to the Bedford College for Women Building Fund by a further grant of 500*l*.

REUTER reports that the council of the University of Paris has sanctioned a scheme for an exchange of students between the Universities of Paris and London.

THE Paris correspondent of *The Times* announces that the Marquise Arconati-Visconti has endowed the University of Paris with the sum of 20,000*l*., which is to be employed for the benefit of the faculties of medicine and of letters.

THE annual meeting of the Mathematical Association will be held on Wednesday, January 10, 1912, at the London Day Training College, Southampton Row, London, W.C. There will be an address by the president, Prof. E. W. Hobson, F.R.S., and the following papers will be read:—on the work of the International Commission on Mathematical Teaching, C. Godfrey; on some unrealised possibilities in mathematical education, G. St. L. Carson; a plea for the earlier introduction of the calculus, C. V. Durell.

IN August last Mr. Snowden, M.P., sent the Prime Minister a memorial, signed by more than 400 members of the House of Commons, urging that the time had come for a new inquiry into the system of appointment and the method of promotion in the Civil Service. The Prime Minister has now replied that the Government has come to the conclusion that such an inquiry, by a Royal Commission, would be useful and opportune. The composition of the commission and the terms of reference will be announced in due course.

WE learn from *The Pioneer Mail* that the Government of India has decided to place Lieut.-Colonel E. H. V. Atkinson, R.E., principal of the Thomason College, Rorkee, and Mr. T. Dawson, principal of the Victoria Technical Institute, Bombay, on special duty early in the new year. The object of the special duty is to bring the technical institutions of India into closer practical relations with the employers of labour in the country, whether they be Government workshops or factories or private concerns. Colonel Atkinson and Mr. Dawson will study the existing requirements of employers of labour, and how far they can be met at existing institutions. They will also make proposals for establishing closer connection between the existing business concerns and the existing technical institutions. On entering any province they will report themselves to the local government, and conduct their inquiries on lines approved by the local government and in the company of any person whom the local government may appoint for the purpose. It is hoped that employers of labour will cooperate with the Government in this important practical work.

THE necessity for the establishment in this country of a lectureship in tropical agriculture forms the subject of a leaflet which has been circulated by Mr. S. Simpson, of 49 Finsbury Pavement, London, E.C., and a copy of which has been received. The departmental committee appointed in 1908 by the Board of Agriculture and Fisheries to inquire into and report upon the subject of agricultural education in England and Wales, put on

record, the leaflet points out, the opinion that universities, in making provision for the training of agricultural experts, are doing not only a national but an imperial work, and one of the recommendations was to the effect that it would assist in the provision of suitable agricultural experts for the development of British tropical and sub-tropical colonies if a readership or lectureship on tropical agriculture were established at one or more British universities. Nothing has yet been done to carry out this proposal. Mr. Simpson urges the pressing necessity for the step, and suggests that the Imperial College of Science and Technology should by all means be the first place at which such an urgently needed lectureship is instituted.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, December 20.—Dr H. N. Dickson, president, in the chair.—W. **Larden**: Solar halos and brocken spectres. The author described some phenomena round the sun which he had observed at St. Moritz in the Engadine. These included (1) brilliant colours not arranged in rings; (2) a series of rings; (3) the large halo of 22° radius; and (4) parhelia, &c. He gave a description of a complicated system of halos and parhelia which he had observed on one occasion at Silvaplana in the Engadine.—W. H. **Dines**: The statical changes of pressure and temperature in a column of air that accompany changes of pressure at the bottom. It appears on investigation that the changes will depend on the manner in which the change at the earth's surface is produced, and also upon the initial vertical distribution of temperature. Furthermore, it is necessary to assume that the air column is bounded laterally by some rigid boundary, otherwise the pressure produced at any given height could not be maintained. The place of such a boundary is probably taken in nature by the lateral acceleration of strong winds, although we do not know how such winds are originated. We do know, however, that in the lower strata the differences of pressure that occur are, on the average, just balanced by this acceleration, and we may reasonably infer that it is also the same at higher levels. Mr. Dines stated that the term "ascending current of a cyclone" has been used, but it appears to be incorrect. The actual phenomena seem rather to be a bulging upward of the strata between 1 or 2 km., and the isothermal a bulging downward of the strata above the isothermal, accompanied with a lateral expansion of the strata below the isothermal.

MANCHESTER.

Literary and Philosophical Society, December 12.—Prof. F. E. Weiss, president, in the chair.—L. E. **Adams**: The duration of life of the common and lesser shrew, with some notes on their habits. The author shows that his recent observations on the moults and habits of shrews confirm his theory that all adult shrews die in their second autumn. His conclusion is based on the following evidences:—(1) all individuals examined during and shortly after December were sexually immature; (2) the genitalia are not atrophied as winter approaches; (3) adult shrews do not moult into winter pelage; (4) the measurements of a large number of shrews show that a maximum size is reached in summer. In his notes on habits, from observation of a captive shrew, he refers to the extraordinary appetite, the nature of the food accepted or rejected, the mode of burrowing, and the limited power of sight.—T. A. **Coward**: A note on the little owl, *Carine noctua* (Scopoli), and its food. Mr. Coward contends that the earlier records of the occurrence of this bird in Britain are founded on doubtful evidence, and do not justify its inclusion in the British list as an occasional wanderer from the Continent. The bird is charged with being destructive to game. The examination of regurgitated pellets throws no light on this assertion, but provides interesting information about its food. The author referred also to the food of the southern little owl, *C. glaux*, mentioning especially the discovery of portions of a *galeodes* in its pellets. He suggests that the inorganic matter in the pellets may be due to the bird's habit of eating earthworms.

EDINBURGH.

Royal Society, November 20.—Prof. Hudson Beare, vice-president, in the chair.—Dr. John **Brownlee**: Point binomials and multinomials in relation to Mendelian distributions. The author showed how the moments about the centre of gravity for any distributed expression such as might arise in Mendelism could be calculated. The general theorem is that if the distributed expression consists of a series of factors, and if the moments of the complete expression be denoted by μ_2, μ_3, μ_4, and those of the factors of which it is made up by

$$\zeta'_2, \zeta'_3, \zeta'_4, \zeta''_2, \zeta''_3, \zeta''_4, \&c.,$$

then

$$\mu_2=\Sigma\zeta'_2 \quad \mu_3=\Sigma\zeta''_3, \quad \mu_4=\Sigma\zeta'_4+6\Sigma\zeta'_2\zeta''_2.$$

By this means the moments of any complex expression such as $(3+1)^n(1+3)^m(1+1)^r$, n, m, r being integers, could easily be calculated, and any continuous curve which arose in the crossing of two characters which were capable of quantitative measurement could be analysed. (1) For pure blending forms such as $(1+1)^r(1+0+\ldots+1)^r$ arise; (2) for blending with partial dominance, forms like $(1+0+2+0+0+1)^n$; (3) for dominance, forms like either $(3+1^n)$, having the dominant elements all coming from one side, or $(3+1)^p(1+3)^q$ if so many come from both blendings; for both these forms the second moment is identical if $p+q=n$, and thus the standard deviation would afford a true measure of comparison even between symmetrical and asymmetrical distributions; (4) if coupling occurred either internal or external there arise forms like $(1+2(n-1)+1)^r$, $(n-1+2+n-1)^r$, where $n=2^r$.—W. **Gordon** and G. H. **Gulliver**: The influence of the ratio of width to thickness upon the apparent strength and ductility of flat test bars of soft steel. The bars were rectangular in section, with a uniform thickness of a quarter of an inch, and widths varying from half an inch to four inches. Neither elasticity nor ultimate strength was appreciably influenced by change of section, but the ductility as measured by the percentage of extension was found to vary considerably. For a fixed gauge-length of 8 inches the extension increased as the ratio of width to thickness varied from 2 to 7, remained sensibly constant as the ratio varied from 7 to 12, and then rose as it varied from 12 to 16. The extreme difference of extension was 10 per cent., or nearly one-half the extension of the narrowest bar. For a variable gauge-length equal to $11{\cdot}3\sqrt{\text{area}}$, similar results were obtained, but the extreme difference of extension was only 2 per cent., or about one-fourteenth of the extension of the narrowest bar. These peculiarities were found to be connected with the changes of section in the neighbourhood of the constriction.—Prof. Sutherland **Simpson**: Observations on the body temperatures of some diving and swimming birds. The large number of birds examined included the storm petrel, cormorant, razorbill, guillemot, grebe, gannet, gull, kittiwake, &c. There were eighteen different species found in the Orkneys, the Firth of Forth, and in and around Cayuga Lake, New York, U.S.A. In all cases in which the sex was determined the rectal temperature was slightly lower in the male than in the female. Of the orders examined, the highest temperatures were found in the Longipennes, the lowest in the Tubinares. The series arranged according to body temperature did not run parallel with the zoological series.—Dr. Thomas **Muir**: The theory of circulants from 1861 to 1880.

December 4.—Prof. F. O. Bower, F.R.S., vice-president, in the chair.—Dr. J. **Stephenson**: *Branchiura sowerbyi*, Beddard, and on a new species of Limnodrilus with distinctive characters. From specimens found in India the author was able to add to our knowledge of the former species, of which only a limited number of specimens had

been so far described.—E. M. **Horsburgh**: The railway transition curve. The mathematical and dynamical conditions to be satisfied by the transition curve by which transition is to be made from one straight track to another were discussed in a new way, and a comparatively simple method deduced for practical setting off of the curve.—A. C. **Cumming** and Alex. **Gemmell**: The preparation and properties of basic copper nitrate, and the hydrates of copper nitrate. Only one basic nitrate was found, namely, $Cu(NO_3)_2,3Cu(OH)_2$. Copper oxide with 100 per cent. nitric acid yields copper nitrate trihydrate, nitrogen peroxide, and oxygen. Copper oxide does not interact with nitric anhydride. The conditions for the formation of copper nitrate trihydrate and hexahydrate, and their range of stability, were studied.—A. C. **Cumming** and E. W. Hamilton **Smith**: The reduction of ferric salts (1) by sulphurous acid and (2) by zinc dust. Ferric salts are most quickly reduced by sulphurous acid if the acidity is kept as low as possible, but if the reaction of the mixture is alkaline no reduction takes place. Various zinc alloys were compared with zinc for the reduction of iron, but offered no advantages. A rapid method for reduction with zinc dust was described.—A. C. **Cumming**: Note on a perforated silica plate for excluding flame gases from a crucible during ignition. The hole was made of the appropriate size to hold the crucible. With this device calcium carbonate was quickly reduced to oxide with a good Bunsen burner.

MELBOURNE.

Royal Society of Victoria, November 9.—Prof. E. W. Skeats in the chair.—Frederick **Stoward**: The effect of certain chemical substances on the vitality of the buds of potato tubers, and their disinfective action on the potato blight (*Phytophthora infestans*). Steeping for three to six hours in 5 per cent. or 10 per cent. sulphuric acid retards growth. Treatment for twenty hours in 10 per cent. solution kills the buds. Steeping for ten days in various disinfectants in very dilute solutions, or even in pure water, prevented germination of the fungus.—F. **Chapman**: New or little known Victorian fossils in the National Museum. Part xiv.—On some Silurian trilobites. *Ampyx parvulus*, Forbes, var. *jikaensis*, var. nov., *A. yarraensis*, *Illaenus jutsoni*, *Encrinurus* (*Cromus*) *spryi*, and *Homalonotus vomer*, are described as new.

BOOKS RECEIVED.

Traité de Géologie. II. Les Périodes Géologiques. By Prof. E. Haug. Fascicule 3. Pp. iv+1397–2024. (Paris: A. Colin.) 11 francs.

Lehrbuch der Biologie für Hochschulen. By M. Nussbaum, G. Karsten, and M. Weber. Pp. xi+529. (Leipzig: W. Engelmann.) 12 marks.

The Year-book of the Learned and Scientific Societies of Great Britain and Ireland. Twenty-eighth annual issue. Pp. vii+374. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*.

The Gentle Art. Some Sketches and Studies. By H. Lamond. Pp. xi+303. (London: J. Murray.) 6*s*. net.

The Age and Growth of Salmon and Trout in Norway as shown by their Scales. By K. Dahl. Translated by J. Baillie. Edited by J. A. Hutton and H. T. Sheringham. Pp. ix+141+plates. (London: Salmon and Trout Association.) 5*s*.

Die Fauna Südwest-Australiens. Edited by Prof. W. Michaelson and Dr. R. Hartmeyer. Band iii., Lieferung 11B. Pp. 395–467+plate. (Jena: G. Fischer.) 4.50 marks.

A Treatise on Plane Trigonometry. By Prof. E. W. Hobson, F.R.S. Third edition. Pp. xv+383. (Cambridge: University Press.) 12*s*. net.

Philips' Nature Calendar, 1912. Pp. 14. (London: G. Philip and Son, Ltd.) 6*d*. net.

Tatsachen und Theorien der atmosphärischen Polarisation nebst Anleitung zu Beobachtungen verschiedener Art. Edited by Prof. F. Busch and Dr. C. Jensen. Pp. 532. (Homburg: Lucas Gräfe & Sillem.)

Penrose's Pictorial Annual. The Process Year-book, 1911–12. Edited by W. Gamble. Pp. xii+224+plates. (London: A. W. Penrose and Co., Ltd.)

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THURSDAY, JANUARY 4, 1912.

THE CLIMATE OF AFRICA.

The Climate of the Continent of Africa. By Alexander Knox. Pp. xiv+552+13 maps. (Cambridge University Press, 1911.) Price 21s. net.

SUCH a work as this has not only become highly necessary, but should be in great demand amongst Governments, mining and commercial companies trading in Africa, missionary societies, and all individuals who intend to visit Africa for any length of time, or to settle in any part of that continent for purposes of health, science, education, or commercial gain. It is to be regretted therefore that the book on its first appearance should contain some needless errors and be chargeable with not a few omissions. And in the hope that some indication of these may be of use in the preparation of a second edition, it may not be thought ungracious on the part of the reviewer to point them out.

First, in regard to the spelling of African names. Nothing is more irritating to those who believe in the desirability of simplifying and standardising the orthography of place and tribal names in all those regions of the world (in other words, all aboriginal America and Oceania, and nearly the whole of Africa and Asia) than attempts on the part of authors to avoid conforming with the standard spelling of the Royal Geographical Society, the Indian Government, the Royal Asiatic Society, the African Society, and most Government departments and learned institutions which are qualified to pronounce an opinion on this subject, and to promulgate a fixed spelling for all parts of the world where no standard has hitherto existed. In some cases this official spelling, though logical as to the use of consonants and vowels, may not have been quite consistent with the original and most widespread native pronunciation of the name. For example, there is no doubt but that the late explorer, Sir Henry Stanley, had a defective hearing (the reviewer speaks from much personal knowledge), and not infrequently wrote down an incorrect version of the native name. No traveller subsequent to Stanley has been able to hear any native of eastern equatorial Africa say "Ruwenzori." Perhaps the nearest form to Stanley's rendering is Runsoro or Runsori (a considerable list of native names of this mountain mass is given in the reviewer's book on the Uganda Protectorate and in the monumental works published in connection with the Duke of the Abruzzi's expedition). But, however that may be, Ruwenzori has long been the form adopted by all Governments and all geographers of any note. Why, therefore, in the work under review should the author introduce a meaningless name of his own—Ru Nzori? There is no linguistic justification for this variant, and in looking through the index it is a matter of inconvenience to find the familiar name Ruwenzori absent.

In regard to the place-name Quelimane. Both the author and several geographical societies and map-makers are at fault. The author spells it phonetically as Kilimane, as though it was a native name. Other authorities give it as Quilimane. Neither is correct. As a matter of fact, the official Portuguese name is Quelimane, which is an ancient corruption of a Swahili-Arab word, Kalimani, meaning "interpreter." This was the nickname of some person who met the ships of Vasco da Gama or other Portuguese pioneers, and served as intermediary between them and the natives. If we are to continue to use the place-names "Moçambique" and "Inhambane," we have no recourse but to go on citing the name of this river mouth on the north of the Zambezi delta as Quelimane. If Mr. Knox desires that his work shall be perfect from the point of view of conformity with the best opinion in the rendering of African names in any further edition of the work, the spelling requires careful revision. The author points out his own spelling of Morocco as Marocco, as though it were preferable to the commonly accepted term. As the phonetic foundation for this name is really Marākesh, we do not seem to gain much by departing from the widely accepted English form, Morocco, unless we go the whole hog and call the land of the Moors either Marākesh or Maghrib-al-Aksa.

In the same way, appendix 1, a glossary of the principal vegetable productions of Africa, except timber trees, by Miss Mary S. Knox, also requires revision and a slight extension to be perfectly useful and unimpeachable. Under the heading of "Acacias" the information is too vague; no species of capsicum (chillies) is *native* to Egypt, the whole of this genus being of American origin. Under the head of "Coffee" nothing is said about the very important species, *Coffea liberiensis*; and the assumption that there is but one species indigenous to or cultivated throughout tropical Africa, *Coffea arabica*, is quite incorrect and out of date. A reference to the works of Auguste Chevalier (amongst others) would enable Miss Knox to give much fuller and more useful information regarding the various species of coffee indigenous to tropical Africa and cultivated therein. It would be invidious to go on pointing out the errors in this appendix, but there are others. Yet it would be comparatively easy to make the whole appendix absolutely accurate and of great interest and importance in correlation with the main part of the book dealing with the African climate.

It is incorrect to say that the indigenous rubber of the Uganda Protectorate is "of poor quality." On the contrary, this protectorate is noteworthy for containing a large number of *Funtumia elastica* trees, which actually produce rubber attaining the highest value, when properly prepared, of any samples, even exceeding occasionally in price the best Para. Although a reference is made to the climate of Liberia (a region which, though small in extent, is very peculiar in flora and fauna—singularly so in fauna—and represents the culmination in rainfall of any part of real West Africa—as distinguished from Central Africa), the information is incomplete and old in date. Had the author glanced at the work on Liberia by the present reviewer, published in 1906, he would have found later and more complete statistics; and there is still further information in the reports and papers

published by M. Auguste Chevalier. In the parts dealing with Sierra Leone and Southern Nigeria, no reference seems to be made to the valuable rain and temperature records kept and published by (or under the direction of) Mr. Frederick Shelford, the chief engineer or constructor of the railways in those countries. Mr. Shelford has made his records sufficiently public in the papers of scientific societies for them to be easily accessible.

The maps contributed to this book by Mr. J. G. Bartholomew under the direction of the author are admirable, and great praise must be awarded to the author for his general research, the clearness with which he sets forth his details and his conclusions, and the way in which he has invested what might seem to be a somewhat uninteresting subject with an interest and an importance sufficient to attract the general reader as well as the specialist. The book, indeed, is so good that it ought to be made as perfect as possible in all its details, which is why the reviewer has expatiated more on these slight defects than on the general excellence of what should prove a standard work.

One last criticism, for the publishers. It might on the whole be better in future editions to paste the twelve maps on monthly rainfall into the body of the work. Although in some ways it is convenient to have them in a pocket and to handle them separately, they are very liable in library use to be lost.

H. H. JOHNSTON.

THE NEW ANIMAL PSYCHOLOGY.

Animal Intelligence: Experimental Studies. By E. L. Thorndike. Pp. viii+297. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 7*s*. net.

ONE of the most remarkable examples of sudden and rapid development of a new scientific method and a new and extensive body of scientific fact is to be seen in the growth of the study of animal psychology during the last ten or a dozen years. As in the case of the general science of psychology, the change came with the introduction of experiment as the fundamental method of investigation, but the transition was accentuated by a craving for objectivity of results, which focussed the attention upon the objective performance or behaviour of the animal under examination, not only to the detriment, but even, in the case of many observers, to the complete neglect of speculation as to its psychical life. If the new psychology claimed to be a psychology without a soul, the new animal psychology threatened, and still threatens, to become an animal psychology without consciousness. Many investigators have indeed openly declared for this ideal—not denying the presence of consciousness, but regarding it as of no importance or value in an explanatory scientific system. Nevertheless signs are not wanting in the most recent work of a healthy reaction from this extreme view, based as much upon observed fact as upon *a priori* speculation.

After the most detailed investigations have been made into the manifold relations of stimulus and response presented by organisms, there is still room to be found for psychical factors of a greater or less degree of complexity, if the explanations are to be complete, although it is a sound principle of methodology that appeal should not be made to them until the possibilities of an exclusively mechanical or chemico-physical explanation have been exhausted. Indeed, it is the new experimental method that has succeeded in demonstrating, in certain cases, the existence of sensations not to be suspected from ordinary observation of the animal. Thus, fish do not ordinarily react to certain musical tones. If, however, such a musical tone is sounded repeatedly when food is supplied to the animal, the latter will ultimately respond to the sound by coming to be fed. In this case, as in many other similar cases, the existence of the sensation or its neural equivalent is demonstrated by the method of association.

Although the general tendency of the science is to become more and more closely assimilated to biology in its methods and explanatory hypotheses, its most marked characteristic at present is a certain distrust of the adequacy of the principle of natural selection to explain the facts, and a greater faith in physical, chemical, and physiological explanations. It shows an equal distrust for finalistic, and, in particular, anthropomorphic views, and is more ready to form its own scientific conceptions and seek the explanation of the more fundamental facts of human behaviour in them than conversely. Its scientific independence is well symbolised by the appearance in America, at the beginning of last year, of a new journal, *The Journal of Animal Behavior*, which is issued bi-monthly, and contains excellent and extremely interesting articles upon the modes of behaviour and (perhaps) consciousness of various kinds of animals. A very complex and efficient technique has been developed, which contrasts with the anecdotal method of the English school of the last generation almost as pronouncedly as do modern chemical methods with those of the mediæval alchemists. One must hasten to add, however, that the well-known works of Prof. Lloyd Morgan form an honourable exception to this method, and are, of course, exempt from the criticism.

In the case of the psychology of vertebrates, it is to Prof. E. L. Thorndike, of Columbia University, that the great credit is due of inaugurating the new methods of research and indicating those modes of experimentation which have met with such signal success at the hands of himself and his successors. The book on "Animal Intelligence" which he has just published is a reprint of four experimental studies already well known to the specialist, viz. "Animal Intelligence; an Experimental Study of the Associative Process in Animals" (first published in 1898), "The Instinctive Reactions of Young Chicks" (1899), "A Note on the Psychology of Fishes" (1899), and "The Mental Life of Monkeys" (1901), together with an interesting introductory chapter on "The Study of Consciousness and the Study of Behaviour," and two concluding chapters, also of a general character, headed "Laws and Hypotheses of Behaviour" and "The Evolution of the Human Intellect" respectively.

It will at once be seen how important the volume is. We have here a compact and well-arranged statement of the views of a classical investigator, alive with the enthusiasm of their first production, and amplified by the maturer judgment of their author. No better book could be put into the hands of the intending research student, or even of the general student of psychology interested in the bearings of the results of experimental animal psychology upon psychology at large.

Thorndike's first research is the well-known one upon the learning-powers of cats, dogs, and chicken, as the result of which he was led to the conclusion that animals at this stage of evolution make little or no use of free ideas in solving the problem of a new situation, if indeed they possess such ideas at all. Hungry cats and dogs shut up in cages, the doors of which can be opened by the manipulation of more or less complex mechanisms of levers, bolts, and buttons which enable them to get at food placed just outside, learn to escape by the method of "trial and error," and by that alone, as is shown by the *gradual* descent of the curves representing the times taken to escape in successive experiments. The resultant pleasure of eating the food upon escape tends to "stamp in" the immediately preceding association of the appearance of the interior of the cage with the impulse and experienced muscular movements involved in working the releasing mechanism. On the other hand, the pain of failure tends to "stamp out" the corresponding misleading impulses, and to prevent their association with the appearance of the box's interior. This is Thorndike's "sense-impulse" theory of learning, which he finds also to apply in the case of fishes and even of monkeys. With the latter the learning is more rapid, but of the same type.

Thorndike discovered no unambiguous evidence in his animals of the power of learning by imitation or by being put through the required movements, whence he concludes that ideas, even if present, are not used in solving such practical problems as he had devised. Some of his critics have stated or tacitly assumed that he denied the presence of ideas in his animals. This is an error. Others have suggested that he did not always succeed in gaining the attention of the animals to the matter in hand, again a criticism which is not justified, since much space is devoted in the memoirs to the discussion of this very point, and success in this is explicitly claimed. Even if later experiments have definitely proved that the power of learning by imitation is present, not only in monkeys, but also in some of the lower animals, and that in so lowly an animal as the frog (see September-October number of *The Journal of Animal Behavior*), "intelligence of a relatively high order" is indicated by the great rapidity with which certain habits may be formed, Thorndike's "trial and error" method remains, if not the exclusive, yet the predominant method of learning in all animals, including man himself.

The book is full of interesting discussions of minor points of psychology—there is, *e.g.*, a most convincing criticism in the "Laws and Hypotheses" chapter of the ordinarily accepted view of so-called "ideo-motor" action—but space does not permit of a consideration of these. Whole books have been written on Thorndike's work, and in a limited review like the present one cannot attempt to do more than summarily state a personal opinion. The book is a very valuable addition to "The Animal Behavior Series," of which it forms the third volume.

WILLIAM BROWN.

THE ASTROLABE À PRISME.

Description et Usage de l'Astrolabe à Prisme. By A. Claude and L. Driencourt. Pp. xxx + 392. (Paris: Gauthier-Villars, 1910.) Price 15 francs.

DURING the experimental period of the *astrolabe à prisme* the authors have from time to time communicated various articles to several papers, in which they have described their apparatus generally and shown its practicability. But the experimental period is now assuredly passed, and this ingenious apparatus may be looked upon as part of a field equipment capable of giving results of the highest precision. Hence its description calls for fuller treatment, and certainly no other instrument was ever awarded a more satisfactory description and discussion than this one is in the volume before us. The work is a manual containing practically all there is to know about the *astrolabe à prisme*, its form, its advantages and defects, its adjustments, and the full treatment of the errors and observed values in securing the most dependable results from its use. It is characteristic of the book that its publication has been several times delayed because new modifications were introduced or new results secured.

MM. Claude and Driencourt were not the original proposers of such a device, for, as they point out in the introduction, the method involved was treated theoretically by Dr. Beck in No. 3102 of the *Astronomische Nachrichten*; but they were unaware of this when they commenced the work in 1903.

The principle involved is the determination of position by the method of equal altitudes, a method inherently good in theory, but somewhat out of repute among practical men by reason of the difficulties of manipulation attending the sextant. In the *astrolabe à prisme* of the present day—a far different instrument from that proposed by Dr. Beck, or those first designed by the present authors—these difficulties are eliminated, and portability, rigidity, and ease of manipulation are now actually features of the instrument.

After relating the history of the development of the apparatus in the introduction, the authors proceed to give a detailed description of the principle in chapter i.; this is no mere description, but is a very lucid and masterly discussion in which it would be difficult to find an omission. A discussion of the adjustments then follows, and we arrive at chapter ii. only to find that discussion and description are again necessary because M. Jobin, the constructor, has so greatly improved the instrument as a field apparatus that a chapter dealing specially with his forms became necessary.

Having learned the principle and construction of the *astrolabe à prisme*, we are next introduced (chapter iii.)

to the method of equal altitudes for the determination of latitude and time, and the application of this method to the particular forms of observation for which the instrument is suited. The problem of determining geographical longitude is treated in the fourth chapter, and forms a very pretty example of astronomical geometry.

The authors are not content with thus having given at length, yet tersely, the fullest instructions as to the principle, the construction, and the use of their admirable device; they now give complete directions as to the preparation of the observations, the preparation and use of tables in the reduction, graphical solutions, and special cases.

The second part of the book is eminently practical, in which actual operations are described, actual tables given, and values from actual observations are reproduced.

It will be seen that the manual is intended to leave no question in reference to the *astrolabe à prisme* unanswered, and the intention has been rigidly followed. For example, in any astronomical operation the question as to the ease with which accidental and instrumental errors may be isolated and eliminated is a crucial one, and to this question MM. Claude and Driencourt pay special attention. Possible, but not obvious, imperfections in the glass of the prism are, perhaps, the chief source of error; therefore they make the determination of the possible amount and action of this error a special feature.

As to the practicability of the method and apparatus, the book contains actual evidence in the observations of the difference of longitude Paris–Brest, and in those made by Lieutenant Mailles in delimitation of the Congo and the Cameroons. In both cases was the *astrolabe à prisme* employed, and in both cases were results of the highest precision secured.

The different types of instrument are well illustrated by diagrams and reproductions at the end of the book.

THE TEETH OF VERTEBRATES.

Vergleichende Anatomie des menschlichen Gebisses und der Zähne der Vertebraten. By Dr. P. de Terra. Pp. xiv+451+200 figures. (Jena: Gustav Fischer, 1911.) Price 12 marks.

TO write a comprehensive treatise on the teeth of vertebrates demands a familiarity with a very wide range of anatomical, zoological, and especially palæontological literature (the book under review contains a bibliography of about 3000 titles!), infinite patience to master and assimilate it, and industry to arrange and set forth so vast a material in orderly fashion. That this colossal task should have been accomplished with some measure of success by a dental surgeon reflects great credit upon the author of this book, Dr. Paul de Terra, of Zürich.

He describes his aim as an attempt to fill what has hitherto been a serious lacuna in German literature, namely, the lack of any book of the nature of the English classic, Tomes's "Manual of Dental Anatomy, Human and Comparative."

He has also endeavoured to supply the generally felt want of a detailed and systematic summary of the scattered literature embodying the results of recent research in odontology—a statement of the facts, and the theories put forward to explain them, in such a manner as to suggest the phylogenetic development of teeth.

Dr. de Terra is of opinion that the time has not yet arrived for compiling an adequate treatise upon the comparative anatomy of teeth, because many of the most fundamental problems relating to the interpretation of the arrangement, structure, and evolution of teeth are still in dispute. He has aimed, therefore, at presenting an impartial statement of all the facts and the views of different authorities, without committing himself to any one explanation. A good example of his mode of dealing with such disputed problems is seen in his non-committal statement (pp. 60–69) concerning the hypotheses of tritubercully and concrescence.

This attitude may perhaps commend itself to the expert reader and be useful to the teacher, who wants a detailed statement of the evidence for and against a particular view; but we think the student has a right to expect from the author of a treatise, who presumably has a much more intimate acquaintance with the evidence than even his writings reveal, some guidance in picking his steps amidst the tangle of conflicting views.

This book is really an encyclopædia of dental anatomy: it deals in great detail with the comparative anatomy of teeth, jaws, and skull, their minute structure, their developmental history, and the discussions that have sprung from attempts to interpret the significance of their form and arrangement. It consists of an introduction, in which such general questions as nomenclature, general embryology, and zoological classification are discussed, and three sections, dealing respectively with (1) the comparative anatomy of the skull and buccal cavity in the Vertebrata; (2) the nature, composition, structure, and significance of teeth; and (3) a detailed systematic account of the teeth in all the vertebrate groups.

The colossal bibliography is well classified; but it includes a number of references to small handbooks on general anatomy, zoology, and embryology which might have been omitted with advantage. Moreover, one may search in vain in this list of literature for many of the most important memoirs on strictly dental anatomy that the last decade has produced. Osborn's important treatise on mammalian teeth is a case in point. Andrews's monograph on the evolution of the teeth in the Proboscidea, which is not mentioned, is perhaps of more importance than the whole of the fifty-six works quoted in reference to this subject.

There are also some curious groupings of mammals: the Sirenia and Cetacea are included in one order (Cetomorpha) and the Hyracoidea are included in the order Proboscidea!

No doubt it would be easy for the specialist to find fault with much of the detail in a compilation such as this. But the book will serve a very useful purpose as a work of reference; and the majority of those who will have occasion to consult it are not likely to be led astray by its inaccuracies or omissions.

G. E. S.

BASIC OPEN-HEARTH STEEL-MAKING.

The Basic Open-hearth Steel Process. By Carl Dichmann. Translated and edited by Alleyne Reynolds. Pp. xii+334. (London: Constable and Co., Ltd., 1911.) Price 10s. 6d. net.

NEARLY half this work is an elaborate chemical treatise on gas-producer practice, and the next ninety pages deal with the chemistry of slag-making and the heat equivalents of the oxidisable constituents charged into the furnace. The remaining portion treats of the various basic methods adopted, from the scrap and carbon to the ore and molten pig-iron processes.

Judging from the tables on German practice the author has been very fortunate in having to deal with pig-irons only slightly inferior in quality to our ordinary hematite varieties, instead of the varied classes of basic pig-iron available in this country; hence the large outputs obtained. Tables on pp. 190, 191, 216, 271, 277, 281, 284, 287, 292, show the character of the practice quoted, which is mainly washing metal and running down to the mildest steel; hence the method of sampling the bath mentioned on p. 230, and the tapping of the bath by the judgment of a sample breaker, even if successful under the very favourable conditions assumed, is entirely unsatisfactory where the sulphur and phosphorus contents are so different, these factors necessitating rapid chemical analysis combined with the malleability test made by subjecting a sample to forging. When the metal in the bath has passed the required malleability test, an addition of ferro-manganese is made to the bath, and, after allowing it time to settle down again, the heat is tapped.

This German and American type of practice with comparatively low phosphorus irons is entirely unsatisfactory with English pig-irons, a return of phosphorus to the metal being the general result, when the phosphoric acid in the slag exceeds 5 per cent. and the silica is fairly high. Additions of hematite pig-iron, containing over $1\frac{1}{2}$ per cent. of silicon or of silico-spiegel, give similar uncertain results. As a consequence the addition of ferro-manganese and other alloys for special steels is made in the ladle, great care being taken that the last of the additions is added well before the slag comes. The percentage loss of manganese in the furnace or in the ladle is given at 40, as per H. H. Campbell's acid practice. This is a mistaken idea as regards ladle practice, as advantage is taken of this even in the acid process to save ferro-manganese, whilst in basic work, with slags low in iron oxide, the loss of manganese is very small with 0·05 per cent. of phosphorus in the metal; about 15 per cent. when the phosphorus is between 0·025 and 0·045 per cent.; and may reach 35 per cent. when the metal has been taken down to 0·01 per cent. phosphorus with 0·07 to 0·12 per cent. of carbon.

The paragraph on recarburisation on p. 239 is very interesting. With skill and experience it is possible with regularity to "catch the carbon" that is to work the process, so that the bath is in a suitable condition for tapping when the desired carbon percentage is reached, instead of running down to a dead mild or almost carbonless bath and then recarburising. The difficulty spoken of in the molten pig and ore process, the impossibility of regulating the slags so as to stop at the desired carbon content, is due to the ore charged having a curious action of its own, a sudden drop of 0·30 to 0·40 per cent. of carbon in the sample in a few minutes even if the slag is practically ore-free. This action is very noticeable when a tapping temperature is attained. If the slag is not in a fit condition for tapping when the required carbon has been reached, it is not good practice to add large quantities of low-silicon hematite or spiegel to increase the carbon. It is much better and more economical to go down for a lower carbon.

The removal of sulphur, that bugbear of the basic steel melter, is discussed on pp. 167–171, and dismissed with the conclusion that it is more profitable to take care that sulphurous materials are not charged into the furnace. This is what everyone would do if he could always get nearly sulphur-free materials to use, but much of the English basic material some of us have to use contains 0·08 and occasionally even up to 0·3 per cent. of sulphur; hence one may easily with such material have 0·2 per cent. of sulphur in the charge when melted. This can be quickly reduced by the combination of heat and lime whilst the carbon is above 0·3 per cent., the trouble with regard to desulphurisation coming when a charge melts out with a low carbon content (p. 194). The sulphur problem is intensified by the fact that materials averaging 0·03 per cent. of sulphur may be charged into a basic furnace and melt out at 0·1 per cent. sulphur even when melting rapidly, owing to sulphur being taken up from the gas when one had to use a coal containing more than 2·5 per cent. sulphur. It is very good work to finish with 0·05 per cent. sulphur in the ingot in such circumstances. Although there is not very much clear guidance on practical working, the book as a whole gives a large number of interesting calculations on matters connected with the reactions directly or indirectly bearing on the general working of the basic open-hearth steel process.

THE GEOLOGY OF NEW ZEALAND.

The Geology of New Zealand: an Introduction to the Historical, Structural, and Economic Geology. By Prof. J. Park. Pp. xx+488+xvi plates, 140 figures, 6 maps. (London: Whitcombe and Tombs, Ltd., 1910.) Price 10s. 6d. net.

THE geology of New Zealand is of exceptional variety and interest. The literature is very scattered, and the valuable reports published by the Geological Survey and Mines Department of New Zealand are often troublesome to those who are not well acquainted with New Zealand topography. Prof. James Park has therefore undertaken a most useful work in compiling a guide to the geology of the dominion; and his book will be an indispensable work of reference owing to its clear account of the stratigraphical and economic geology, the detailed bibliography of fifty-eight pages, and the many beautiful plates of New Zealand fossils. The book is well

printed, and the new illustrations are all excellent; but a few of the old figures taken from the Survey reports, such as Fig. 72, might have been omitted as unworthy of place beside the new figures. Prof. Park's work not only shows what has been done, but directs attention to the problems which are still matters of vigorous controversy in New Zealand, and to various conclusions for which the evidence is still unconvincing.

The author is to be congratulated on many features of the stratigraphical classification adopted. Thus the Maitai series is now referred to the Carboniferous, a conclusion for which the evidence appears adequate, for the supposed Inoceramus, which led to the reference of the series to the Mesozoic, turns out to be an inorganic structure. The famous Cretaceo-Tertiary system of Hector has finally disappeared. It was based upon the commingling of fossils from two distinct horizons; and Prof. Park describes one of the beds to which some of these fossils were attributed as quite unfossiliferous. The volume includes a valuable note by Mr. F. Chapman on the correlation of the Oamaru series, which, with their Australian equivalents, he assigns to the Miocene. One may be excused for suspecting whether a stratigraphical difficulty in regard to the Kaihiku series is not due to another mixture of fossils.

Prof. Park's identification of the Maniototo series, the lowest part of the Manipouri system, as Cambrian appears to be the most doubtful point in his classification. The lithological characters of the Maniototo rocks are characteristically Archean, and though they are overlain by the graptolitic Kakanui series, which is Ordovician, far more convincing evidence than any yet forthcoming will be needed before the underlying gneisses can be safely accepted as Cambrian. The author is disposed to take a perhaps somewhat extreme view as to the range of the Pleistocene glaciation in New Zealand. His discussion and photographs of the well-known Taieri moraine give more satisfactory evidence of its glacial origin than any previously published. Prof. Park admits that the explanation of the Taieri moraine is still incomplete; that moraine is very far south and the evidence that glaciers reached sea-level further to the north is less satisfactory. He gives an interesting account of the glaciers and glacial deposits around the peaks of the North Island, and his account of the Tarawera eruption, with the exception of his recent paper in *The Geographical Journal*, is the best account of it yet written.

Prof. Park gives a very interesting account of the fault system of New Zealand, and admits the great influence faults have played on the existing geography of the country. He thus justifies the conclusions of Mackay, which were once so discredited in New Zealand. The account of the economic geology of New Zealand is of especial importance; but the author appears to be unnecessarily alarmist as to the approaching exhaustion of the world's stores of iron. "In two centuries or less," he says, "the battleships will be beaten into ploughshares and the ploughshare will be treasured by each family as a priceless heirloom." He makes the very sound proposal (p. 292) that some of the coalfields should be reserved for naval purposes; for since much of the power required on land can be derived from water, he holds that factories and domestic consumers should not be allowed to exhaust the fuel, which he thinks will always be indispensable for use at sea. Prof. Park makes no reference to the oilfields of New Zealand, to which prominent attention has recently been directed elsewhere.

J. W. G.

OUR BOOK SHELF.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1912. Edited by G. E. Brown. Pp. 1436. (London: Henry Green and Co., n.d.) Price 1s. 6d. net.

OUR readers are so familiar with this bulky but indispensable accessory to the photographic studio that the mere announcement of the new issue is enough to make them obtain their copy. With 1436 pages the book is a veritable mine of information, and not only is it now almost a standard book of reference, but it is instructive in a host of ways. This year the editor contributes a very valuable article on lantern-slide making, and as this subject is a very popular one to-day, it should find a great number of readers. No less instructive is the admirable way Mr. C. H. Hewitt tells us how both in- and out-door portraiture may be successfully accomplished without any special appliances, and with the ordinary camera and lens; the article is also well illustrated with eleven examples of specimen work.

The "Epitome of Progress," by the editor, is full of interesting material, hints, and dodges, and the method of obtaining the effect of a portrait having been taken in a high wind is a good illustration of the last mentioned. In the section devoted to the recent novelties in apparatus, the editor occupies about eighty pages, so numerous are the articles to which reference is made. "How to do it" is the title of the section which gives 120 hints in picture form. Each picture is a hint showing how to select a hand or stand camera, use a tripod, carry the camera on tour, copy drawings or pictures, &c. There is little doubt but that this section will be considerably enlarged in the next issue. Mention need only be made of the lists of formulæ, tables, miscellaneous information, &c., and other distinguishing features which go to make us this useful volume.

While the book contains numerous diagrams and other illustrations, we may perhaps direct special attention to the very excellent three-colour print by Willfried Deyhle, of Berlin, from a photograph by F. Leiber, entitled "Kongsbay on Spitzbergen," taken with a Zeiss-Tessar f/4·5, equivalent focus $5\frac{1}{4}$ inches. The book concludes with full indices of the text, the advertisers, and the goods advertised.

Alpine Plants of Europe, together with Cultural Hints. By H. S. Thompson. Pp. xvi+287. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7s. 6d. net.

A VALID claim for originality is preferred by the author on the ground that this volume contains descriptions of plants from all ranges of the Alps, and it may be added, that a few species of extra-alpine habitat are included, as *Iberis gibraltaica*. The altitudinal signification of the work "Alpine" is also implied, so that for the most part the species noted find a congenial home at a higher elevation than 5000 feet. Inclusion of all the alpine species growing within the area has

not been attempted; in fact, only nine species of Carex are included, and the list of grasses is limited to one species from each of eight characteristic genera. But for the more interesting alpine genera the list is nearly complete; thus, under Saxifraga about fifty species are described, and a few others are mentioned; this is very inclusive, although the species *Rudolphiana* and *Clusii* do not appear.

Most botanists are aware that Mr. Thompson has an intimate knowledge of the Alps and is familiar with many of the floral rarities; they will therefore be prepared to find the concise descriptions and useful critical notes that form a prominent feature in the book. Another subject on which Mr. Thompson is equally qualified to advise is the cultivation of alpine plants, and this aspect of the book, dealing with a popular hobby, is likely to attract so much attention that, contrary to the opinion expressed in the preface, one is inclined to say that it will be more sought after and used by the enthusiastic cultivator of alpines than by the ardent botanist who wishes to find and identify alpine species. The latter would in the first instance prefer a local flora that includes all the plants of the country; but subsequently he would find the present work most desirable for corroboration, critical determination, and comparison with allied species from other countries. There is a measure of inconsistency in the omission of generic descriptions for many genera, but this does not detract from a book which is primarily valuable for its expert and critical information. The three hundred coloured illustrations are on the whole accurate in the matter of form and colour. Certain general facts and the broad outlines of cultivation are discussed in three interesting introductory chapters.

Vocabulaire Forestier: Français—Allemand—Anglais. Par J. Gerschel, revu par W. R. Fisher. Cinquième édition, considérablement augmentée. Pp. vi+192. (Oxford: Clarendon Press, 1911.) Price 5*s.* net.

THIS is the fifth edition of a dictionary in French, German, and English of the technical terms which are usually met with in books on forestry in those languages. Compiled by Dr. Gerschel, late professor at the Nancy Forest School, the present edition was revised by the late Prof. W. R. Fisher, of Oxford, shortly before his death, and is now issued by the Clarendon Press. The book contains 192 closely printed pages, and is very useful, as it not only includes the technical terms peculiar to the art of forestry, but also most of the common terms of the sciences of botany, zoology, and geology, and, in addition, words pertaining to hunting and shooting. The German and French parts appear to be well done; but the English part requires to be thoroughly revised, as it contains many curious errors and omissions.

A good many words are doubtful or obsolete English, as "imp" used instead of "graft," "wood-apple tree" instead of "crab tree." "Virginian climber," p. 149, is commonly called "Virginia creeper," and "forest science," p. 149, should be "science of forestry."

Printer's errors are not uncommon, as, p. 20, "*Picea excelsa*, Hink," should read "Link"; p. 142, "*encelsa*" should read "*excelsa*"; p. 152, "*Liquidamber*" should read "*Liquidambar*"; and p. 175, "Scot's fir" should read "Scots fir." The statements made on p. 164 that the "durmast" is the "Turkey oak" and that "*Q. coccifera*" is the "scarlet oak" are erroneous. "Oseraie," p. 190, is not "willow culture," but "osier-bed."

An objectionable feature in the English part is the constant use of hyphens, where they are not usually employed, as "expectation-value," "coppice-with-standards," which are usually printed "expectation value," "coppice with standards."

It is to be hoped that in the next edition these obvious faults, which impair the value of this useful book, will be removed.

Reports from the Laboratory of the Royal College of Physicians, Edinburgh. Edited by Sir John B. Tuke and Dr. James Ritchie. Vols. x. and xi. (Edinburgh: Oliver and Boyd, 1911.)

THESE two handsome volumes are evidence, if that were needed, of the activity of research in the laboratories of the Royal College of Physicians of Edinburgh. They are also a testimony to the valuable work which may be done by means of the funds of a private corporation, aided in this case by a grant from the Carnegie Trust. The papers (which have all appeared elsewhere) are divided into four groups, those appertaining to anatomy, pathology, pharmacology, and physiology. All appeal to the specialist, and it is not possible to select any for special comment.

Of some general interest is the dietary study of the five halls of residence for students in Edinburgh, by Miss J. D. Cameron. The average cost per man per day (exclusive of condiments and beverages) is 15·1 pence, of which 66 per cent. is expended on animal food. The waste varies considerably, from 2·4 to 7·0 per cent. of the total money spent on food, but is about one-half of that in the American studies of college residences.

Dr. Berry Hart discusses the nature and origin of the "free-martin"—an apparently sterile cow, co-twin with a potent bull—of which John Hunter described three specimens, the organs of which are preserved in the museum of the Royal College of Surgeons, London. It seems to be established that the free-martin, when the co-twin is a potent male, is a sterile male, and not a sterile female. R. T. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

January Meteor-showers, 1912.

THE following are the computed particulars of the meteor-showers which become due during nearly the first fortnight in January:—

Epoch 1912, January 4, 11h. 30m. (G.M.T.), twenty-first order of magnitude. Principal maximum, January 3, 2h. 55m.; secondary maxima, January 3, 9h. 50m., 13h. 40m., and January 4, 10h. 25m.

Epoch January 5, 10h., approximately ninth order of magnitude. Principal maximum, January 6, 4h. 10m.; secondary maximum, January 6, 15h. 35m.

Epoch January 7, 0h. 30m., thirteenth order of magnitude. Principal maximum, January 5, 18h. 20m.; secondary maxima, January 6, 9h. 40m., and 19h. 30m.

Epoch January 7, 6h. 30m., fifth order of magnitude. Principal maximum, January 6, 22h.; secondary maxima, January 5, 21h., and January 6, 15h. 45m.

Epoch January 8, 2h., approximately eighteenth order of magnitude. Principal maximum, January 8, 3h. 35m.; secondary maxima, January 9, 2h. 30m. and 20h. 40m.

The first few days of January are comparatively quiet, the greatest meteoric activity occurring during the period January 5–9. The Quadrantid epoch of January 4, which is not so strong as the corresponding epoch of 1911, has its principal maximum early on the afternoon of January 3, but the other maxima will probably furnish some bright meteors, notwithstanding the presence of a full moon.

Dublin, December 23, 1911. JOHN R. HENRY.

Microkinematography.

In the article on "Microkinematography" in NATURE of December 14, 1911, there are one or two points which are expressed in a manner that may lead to misconception. Dealing with these as they occur, is it correct to describe the process as having been developed during the last few months? The method adopted by M. Comandon was described in *La Nature* so long ago as November, 1909, and reproductions of kinematograph films were used to illustrate the paper. In this country, too, Dr. Spitta has done and has exhibited numerous examples, and I believe I am right in stating that his work extends back to an even earlier date.

The method of illumination, which in any case is quite well known and in use in every well-appointed bacteriological laboratory to-day, is described as an application of the "ultramicroscope." This is incorrect. Illumination has clearly been effected by means of a paraboloidal or spherical surface dark-ground illuminator, and with this appliance any object, such as a bacterium or trypanosome, which is within the limits of the resolving power of the objective used, may be rendered visible.

In the ultramicroscope, much smaller objects than these are dealt with, but owing to the method of illumination the images obtained are not of necessity an indication of the size or form of the objects under observation. They appear as diffraction discs, which are visible or invisible, and vary in apparent size, according to the intensity of the source of light used.

In the case of certain colloids, for instance, it is possible to observe particles that approach molecular dimensions, and no ordinary method of dark-ground illumination could accomplish this.

Confusion of thought often arises from failure to appreciate that there is an important difference between the limits of visibility and of resolution in the microscope. The objects shown in the paper in question are well within the limits of resolving power of even a high-power dry objective, so that they are in no sense "ultramicroscopic." The term should only be applied in cases where the objects are in all dimensions beyond the limits of resolution of the best objectives, where special arrangements are necessary in setting up the object to ensure that only the particular layer under observation is illuminated, and where the source of light is of sufficient power to render visible isolated particles which are much smaller than the resolution limit. The subject is one on which much might be said, but it is clearly impossible to do more than indicate the line of argument.

Spirochaeta pallida is especially referred to, but even this is easily and perfectly shown under ordinary laboratory conditions by a dark-ground illuminator.

Is the statement literally true that "some thousands of successive photographs" are taken per minute? If so, then it appears to be necessary to give a much shorter exposure in the kinematograph than when taking instantaneous photographs of any of the subjects illustrated. Without wishing in any way to minimise the achievements described, it should be borne in mind that the main difficulty is the almost prohibitive cost. There are many photomicrographers who are competent to carry out such work and to overcome such technical difficulties as exist, but there are scarcely any who are able to face the great cost of the films. In the present case, the immense resources of Messrs. Pathé Frères have been placed at the disposal of the worker, so that this difficulty has not been experienced.

J. E. BARNARD.

King's College (University of London),
Strand, W.C., December 18, 1911.

It may be admitted that the word ultramicroscope is misplaced, and its use may inadvertently cause some confusion, though the remarks which immediately follow should prevent any possible misconception as to the method employed. The large cost involved is, of course, a consideration of great importance to those actually concerned in the production of the films, but scarcely one to be insisted on in an article such as that under discussion.

THE WRITER OF THE ARTICLE.

UNIVERSITY EDUCATION IN LONDON.

We published on June 15, 1911, an article giving some information as to the proceedings which led up to the appointment of the Royal Commission on University Education in London, and dealing with the second volume of evidence issued by the Commission. The third volume of evidence [Cd. 5528, price 3*s*. 8*d*.], recently issued, contains the evidence presented between November 10, 1910, and July 28, 1911. Much of this evidence is not of direct interest from the point of view of the promotion of science, dealing as it does with such matters as legal education, the position of individual colleges, and the relation of the University to secondary education, though the discussion of these questions is of importance as indicating the general form of organisation for the University which the Commission will propose, and which must in the future exercise a potent influence over scientific education in London and elsewhere. There are, however, two subjects of more immediate interest on which a good deal of new evidence is now published; first, the work and government of the Imperial College of Science and Technology at South Kensington, and its future relations to the University; and, secondly, the organisation of medical education in London. Each of these questions is extraordinarily complex, and might well engage the sole attention of a Royal Commission; and it will only be possible in a short article to indicate in a rough way the character of the evidence presented.

The witnesses for the Imperial College, who were heard on February 23, 1911, were Lord Crewe, the chairman of the governing body, Sir William White, Dr. R. T. Glazebrook, Mr. R. Kaye Gray, and Sir Alfred Keogh, and their evidence was based on the following resolution adopted by the governing body:—

The Imperial College of Science and Technology having been established "to give the highest specialised instruction, and to provide the fullest equipment for the most advanced training and research in various branches of science, especially in its application to industry," the governing body is of opinion that, in order to attain the purposes contemplated—

(i) The autonomy of the Imperial College should be maintained, and incorporation with the University of London should not take place; and

(ii) Some means shall be found, either by the establishment of an independent department or faculty of technology or otherwise, by which students of the Imperial College of Science and Technology who satisfactorily complete the associateship courses of the college, and students duly qualified by research, advanced study, or in other approved ways, may obtain degrees without further examination.

Throughout their evidence the witnesses laid great stress on the importance of the higher, or post-graduate, work of the college, especially in its industrial aspects, and the action already taken by the governing body in developing this side of the work of the college was fully reported. With reference, however, to the basing of the claim for autonomy on this special characteristic of the work of the college, the witnesses were subjected to somewhat severe examination by Sir Robert Morant in regard to the obligation imposed on the governing body in the charter to carry on the work of the Royal College of Science and the Royal School of Mines, which has been in the past, and, as statistics published in the volume show, is at the present time mainly undergraduate—that is, of the standard required for the first degree of a university. In reply, it was contended that the governing body had power to modify the courses in these colleges; but Sir Robert Romer

thought that the extent to which this power could be exercised under the present charter was one for a court of law.

"I doubt," he said, "if you could change it. You could not change its nature substantially. It is a question of substance. Minor modifications undoubtedly, but anything which would really change the nature of the school you have no power to do, and it would be changing the nature of it, if chiefly occupied with pre-graduate instruction—it would be a substantial alteration in my view—if you changed it into a post-graduate system of education" (Question 7840). To this Sir William White replied: "If it were considered desirable, on national grounds, to make the change, that would mean an alteration of the Charter."

This important question is discussed elsewhere in the evidence. Sir Arthur Rücker expressed himself as strongly opposed to the policy.

"If this policy were adopted at present," he said, "the institutions forming the Imperial College would be ruined financially. Then, again, it is more than doubtful if the ideal of having none but post-graduate students can be attained. The well-known case of Johns Hopkins University is in point. It started as a post-graduate institution, with the best professors that could be got, and it was a most successful institution, but some five or six years ago they had to give up their scheme, and the latest statistics I have looked at showed that about one-fourth of the college consisted of undergraduates, instead of being wholly post-graduate. I do not think that what, under the most favourable conditions, failed there is likely to succeed in London, and, if it does succeed, success cannot be attained for a very long time. We have already had something like 700 students; we are now spending just on a quarter of a million pounds on new buildings, and, putting it at a very low figure indeed, could very easily have 1000 students. If there were none but post-graduate students there, they would take up more room than the ordinary undergraduates, but if we say only 700, I think the ideal of having 700 post-graduate students in technological subjects concentrated in one institution in London is at present absolutely chimerical" (Question 9094).

While, however, the witnesses for the Imperial College maintained generally their claim to autonomy, they discussed in a not entirely unfriendly way the possibility of devising some faculty organisation in the University which would meet their special requirements. Such an organisation they regarded as a second-best alternative to the establishment of a distinct technological university, as to which, however, not much encouragement was forthcoming from the Commission. The chairman stated, early in the evidence, that "The Commission feel, that if it can be avoided, it is not desirable that there should be two bodies of university rank in the London area" (Question 7727), and this question was not further discussed.

In the evidence of Prof. M. J. M. Hill, then vice-chancellor, some interesting information is published, we believe for the first time, on the proposals put forward by the Senate of the University before the issue of the charter for the Imperial College, from which it appears that the Senate was prepared to consent to some alteration of its own constitution in the direction of increasing the representation of technical interests, and it advocated the government of the Science College and the Technical College by distinct committees.

With reference to the organisation of medical education in London, some very interesting evidence is published by Mr. Abraham Flexner, of the Carnegie Foundation of New York, Prof. Friedrich Müller, of Munich, Sir William Osler, and others. There appears to be general agreement as to the urgent need for the reorganisation of the London medical schools in order to promote in a more thorough way the scientific study of medicine. It was admitted by several witnesses that London students have exceptional advantages in the amount and variety of clinical material available in the hospitals, but the system under which the clinical teaching is almost entirely undertaken by physicians and surgeons whose time is very fully taken up in the practice of their profession was considered to be defective, though there was no strong feeling that even the principal teachers should be rigidly barred from professional work. The Continental and American systems of hospital clinics are described in detail, and the desirability of organising one or more of the London hospitals and medical schools on similar lines is considered, with reference both to the financial aspects of the question and the difficulties arising from vested interests. As, however, the medical evidence is not at present complete, it may be well to defer further consideration for the present.

The fourth report of the Commission [Cd. 6015] was published on December 23. This is substantially the first report, for it is the first document which has been issued in which the Commission gives expression to its corporate opinions. On the whole the report must be pronounced as reassuring, for it shows that the Commissioners have risen above petty and sectional jealousies, and have formed a high ideal of the University which London should possess. The Commissioners evidently wish the University to put its house in order in a physical sense as a preliminary to a scheme of reorganisation in an academic sense, for the report deals exclusively with the need for a permanent building for the University, "appropriate in design to its dignity and importance, adequate in extent, and specially constructed for its purposes, situated conveniently for the work it has to do, bearing its name, and under its own control."

The present building of the University at South Kensington is condemned for various reasons, in particular its situation, Government ownership, and inadequacy. In adumbrating the form of new building required and the purposes to which it is to be put, the Commission is forced to deal to some extent with vexed questions of policy, but it lays special stress on the need for a great hall and for suitable accommodation to promote the social interest of teachers, graduates, and students. Lecture halls and some library accommodation would be required, but the Commission defer any definite judgment on the policy which has been urged upon them from some quarters of providing a series of research laboratories in direct connection with the University.

The Commission, in the last paragraph of its report, appeals in eloquent terms to the generosity of benefactors in order that an endowment may be provided for a reconstituted University, and a new building may be available which would be a visible sign of its recognition and acceptance as a great public institution. "A great university is not self-supporting, and can never be so. As an institution for learning, in which liberal education, instruction in the methods of advancing knowledge in a wide range of subjects, and the highest professional training, are combined with large scope for the free exercise of thought and with full opportunity and encouragement for the systematic prosecution of research, it can never exist financially on the fees of its students." The report is dated December 15, 1911, and is signed by all the Commissioners.

LIQUID CRYSTALS.[1]

DURING the seven years that have elapsed since the publication, in 1904, of his previous book, entitled "Flussige Kristalle," Prof. Lehmann has in no way abated his energy, and has poured out a constant stream of papers giving the results of, and the deductions from, further observations, so that another or at least a supplementary work is already called for. Prof. Lehmann decided to write an entirely new book, which, being complete in itself, would readily enable any reader interested in the subject to learn what has been done in it and what is the present situation. The subject is not easily understood, and most of the experiments upon which it is founded cannot be performed without special apparatus. It has so far received scanty attention in this country, and its extreme importance is perhaps not fully realised. Outside Germany Prof. Lehmann has given demonstrations before the Mineralogisch-Petrographische Gesellschaft in Vienna, and the Société Française de Physique in Paris; may we not hope that some society in this country will be sufficiently enterprising to induce Prof. Lehmann to give a similar demonstration in London? No one who has witnessed these beautiful phenomena can fail to agree in the main with Prof. Lehmann's conclusions; to see is to believe, and, as Prof. Lehmann says (p. 5), "jeder, welcher Gelegenheit hatte die Versuche zu sehen, sich davon überzeugte, die Erscheinungen könnten unmöglich anders gedeutet werden."

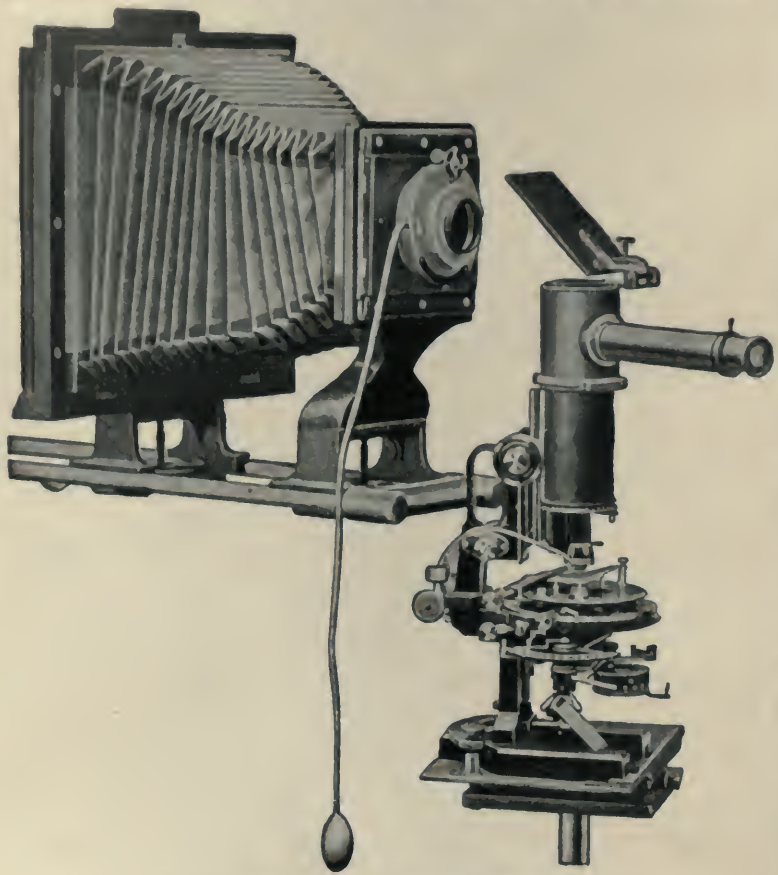

FIG. 1.—Crystallisation-microscope with camera attachment.

The tendency during the past forty or fifty years was for active workers in science to become specialists, *i.e.* to confine their attention wholly to one or two small compartments, and to pay little or no heed to what is being done by others in contiguous compartments; the most striking feature, on the other hand, of recent development of science is the revelation it has afforded of the true interdependence subsisting between the so-called branches of it. This is eminently true of crystallography; for long regarded only in its general aspect as an adjunct of physics and in its specific aspect of mineralogy, it is already recognised as of considerable importance to the chemist and petrologist, and now Prof. Lehmann tells us that crystals are potent factors in the processes of life, and therefore that they form a subject with which biologists should be cognisant.

The field of research into which Prof. Lehmann struck out nearly forty years ago was then so utterly unknown and yielded such amazing results that it is no matter for surprise if his early reports were received with the scepticism usually accorded to travellers' tales. His observations were set down as optical illusions, and his conclusions vigorously combated, but the passage of time has gradually brought about a change, and at the present day most of those who have given any serious study to the subject are in general agreement with him; for instance, Prof. Wallerant, the eminent French crystallographer, has remarked, "La découverte de M. Lehmann est certainement une des plus importantes du siècle dernier; ses conséquences sont nombreuses et de premier ordre

FIG. 2.—Liquid crystals between crossed nicols.

[1] "Die neue Welt der flüssigen Kristalle und deren Bedeutung für Physik, Chemie, Technik und Biologie." By Dr. O. Lehmann. Pp. vii+388. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1911.) Price 12 marks.

et elles permettent en particulier de préciser nos connaisances sur la structure des corps cristallisés." The change is not without its drawbacks; Prof. Lehmann finds complacent acceptance more irritating than ignorant scepticism, and complains (p. 5), "In neuester Zeit machen sich sogar Stimmen geltend, die glauben machen wollen, es handle sich um eine längst bekannte Sache, die ganz selbstverständlich sei."

We discussed the scope of Prof. Lehmann's researches two years ago (1909, vol. lxxix., p. 286), and need not traverse the same ground again. The present volume is naturally more coherent and easier to read and digest than a series of isolated papers published in various journals, and it may be commended to all who would fain learn of a remarkable subject. In chapter x. the author gives, with illustrations, descriptions of the various forms of the crystallisation-microscope, the invention of which rendered his researches possible. The principal conclusions arrived at may be summed up briefly. The old idea of a crystal as necessarily a rigid body bounded by plane faces must be definitely abandoned, as the author says (p. 149), "Demnach gehört auch die Bildung in ebenflächiger Form nicht unbedingt zu dem Kristallbegriff." Crystals may, indeed, be solid and rigid, and liquid and mobile, and there is no break in the transition from one sort to the other. The ultimate particles are invariably anisotropic. Isotropic crystals result from the neutralisation of the action of the particles by their mutual arrangement, which is regular; amorphous substances, on the other hand, are isotropic because their arrangement is irregular. Prof. Lehmann points out (p. 194), "Dass regulär Kristalle durch Zug und Druck doppelbrechende werden, ist veilleicht teilweise darauf zurückzuführen, dass sie anisotropen Molekülen bestehen, welche verdreht gegeneinander angeordnet sind, so dass keine Richtung bevorzugt wird." We are left therefore with, as the fundamental character of a crystal, its power under suitable conditions to grow; it is thereby sharply differentiated from an amorphous mass, which cannot in any circumstances grow. It is this important character which has led Prof. Lehmann to believe that crystals are the agents in the growth of living organisms. The curious and beautiful silicate-vegetation affords an instance of growth of purely unorganised matter. The close similarity in behaviour and appearance between certain kinds of crystals and bacteria has often been remarked, and cannot be dismissed as accidental.

FIG. 3.—Silicate-vegetation.

Prof. Lehmann gives us a lucid exposition of the subject which has constituted his life's work and has been developed almost solely by himself, and the reasoning is rendered easier to follow by the aid of numerous excellent illustrations, three of which we are permitted to reproduce here. An index, which might perhaps have been fuller, is provided. The printing and the paper used are both good.

THE TIDAL SURVEY OF JAPAN.

IN the Journal of the College of Science of Tokyo for April, 1911 (vol. xxviii., article 7), Prof. Hirayama publishes results derived from tidal observations made during the last sixteen years at fourteen places distributed round the coasts of Japan and Formosa. The tide-stations were administered by the Land Survey, but the reductions are in the department of the geodetic committee, of which Prof. Terao is president.

The sites of the observatories have been carefully chosen so as to give good representations of the tides in the neighbouring seas, and twelve of the stations are permanent establishments, while two are temporary. Samples are given of the tide-curves recorded at nearly all the stations, and it is clear that perturbation due to seiches has been slight. Many of the observatories are at somewhat inaccessible places, and therefore the clocks of the gauges were regulated by the aid of a simple form of sundial. The gauges themselves were for the most part of Lord Kelvin's pattern, and have been found very satisfactory. The paper shows that the work has been carried on with Japanese thoroughness.

In the office of the United States Coast Survey a number of stencil plates pierced by holes are laid successively on the tabulated hourly values of the heights of the water, and the numbers which are visible through the holes are those which are to be added together to form the sums required to furnish the data for harmonic analysis. The late Dr. Börgen attained the same end by means of sheets of tracing paper laid on the tabulated values which indicate by zigzag lines the columns for addition. Prof. Hirayama tried both these plans, but he finally concluded that the use of my tidal abacus[1] was the most convenient method, and it alone was used. The work involved in treating the observations at the fourteen stations must have been enormously laborious, as no fewer than sixty-six years of observation have been reduced.

I have not tried to make a minute examination of

[1] Proc. Roy. Soc., vol. lii. (1892), p. 345, or "Scientific Papers," vol. i. p. 216.

the harmonic constants tabulated, but the following are some conclusions which may be drawn.

On the Pacific coast the diurnal and semi-diurnal tides are both nearly "inverted," and the tide-wave reaches the north-easterly parts of the islands somewhat earlier than the south-westerly coasts. The diurnal inequality is large. The Japanese Sea is almost a lake, and it is natural that the range of tide on the western coast should be much less than on the east; it is, in fact, only about one-seventh as great. But the phases of the tides are puzzling, for it is diurnal high-water almost simultaneously throughout the Japanese Sea at the same time that it is diurnal low-water on the Pacific coast, and the diurnal amplitudes are not very different throughout. On the other hand, the semi-diurnal phases on the west are so diverse that it is not easy to interpret their meanings, and there is some diminution of amplitude to the north. If the Straits of Korea are wide enough to admit the diurnal wave so freely, why is the semi-diurnal tide so much broken up? These questions deserve more attention than I am able to give to them.

It seems a pity that in the tables of harmonic constants the heights should be given to one-tenth of a millimetre, and the phases to the hundredth of a degree, for this degree of accuracy is quite fictitious, as may be seen by a comparison of the values at any port for successive years. It may be well also to direct attention to the values of the phases assigned to the tides M_2 and O for the port of Tonoura for the year 1895. There must be a mistake, because for that year they are entered as being almost 180° different from the values for all the successive years. There is no misprint, because the suspicious numbers have been used in forming the mean values of M_2 and O. It is clear from the values assigned to these tides at other ports that 1895 was not an abnormal year—and indeed such an amount of abnormality would have been nearly incredible. No doubt the source of error will easily be discovered.

The tidal constants round the Japanese coasts have now been accurately determined, and Prof. Hirayama deserves warm acknowledgment for the care which he has bestowed on his laborious and useful task.

G. H. DARWIN.

FISH PHOTOGRAPHY.[1]

DR. WARD'S book consists really of a fine series of photographs illustrated by a rather inadequate text. Considerable trouble has been taken by the author to represent British marine and fresh-water fishes as they would be seen by a human observer placed in much the same conditions as the fishes themselves. Many, for instance, were taken from an observation chamber built below the surface of water in a shallow pond, and others have been made from fishes living in tanks, lighted in various ways. The author gives a good account of these methods, which may be of assistance to those engaged in original work. The book also includes a number of microphotographs of eggs and larvæ of both fresh-water and marine fishes, and some of these are novel.

The author tells us, in his introduction, that he has endeavoured to show how fishes disclose their mental states in their attitudes and colour changes. The psychology of the pike and perch—contemplation, mental agitation, the rigidity of excitement, doubt, disappointment, disgust, alarm, &c.—are revealed (to Dr. Ward, at all events) by these attitudes. The interpretations may well be doubted, but the photographs themselves are interesting and beautiful. The author is more successful in his illustration of concealment-devices. Thayer's principle of counter or obliterative shading is extended to fishes. The darkening of the dorsal, and the lightening of the ventral surface produce, in a fish lit from above, a flat, ghost-like effect, well shown in the photograph of the dace on p. 26. The fusion of colour patterns with that of the background is illustrated by fine photographs of lemon sole and thornback ray lying on the sea bottom. A further device, imperfectly elaborated by the author, is the concealing effect of the reflection of light from silvery fishes, and the similar effect of the confusion of the iridescence of

FIG. 1.—Lemon Sole seen against a white background. From "Marvels of Fish Life."

FIG. 2.—The same fish in natural surroundings. From "Marvels of Fish Life."

[1] "Marvels of Fish Life as Revealed by the Camera." By Dr. F. Ward. Pp. xiv+196+plates. (London: Cassell and Co., Ltd., 1911.) Price 6s.

such fishes as the mackerel and herring with the shimmering produced by light transmitted through a water surface broken by waves.

Many of the photographs of the eggs and young stages of fishes are very well done; we may direct particular attention to the series representing the hatching of the salmon egg, on p. 50; those illustrating the early stages of the roach on pp. 104–5, and the series taken at Port Erin Hatchery, which represents the larval metamorphosis of the plaice. All these are probably better than any hitherto published.

The defects of the book are in the text, which is sketchy and slight, and is not free from errors. The author evidently confuses the eel and lamprey on p. 126, for he speaks of the former fish as possessing several gill openings behind the pectoral fins. Haddocks (p. 129) are said generally to feed on herring eggs—certainly an exceptional habit. Skates, rays, and dogfishes are said to eat oysters (p. 150)—one would like to know where these observations were made. The starfish is also described as protruding its stomach and engulfing an oyster (p. 150)—surely this is impossible! Floating fish eggs are said to occur throughout the year (p. 109). The photograph opposite p. 190 is described as that of a shrimp. Evidently it represents a shank (Pandalus).

J. J.

FIG. 3.—Hatching of the Salmon. From "Marvels of Fish Life."

FRANCE AND THE ENDOWMENT OF RESEARCH.

THE French intellect is proverbially clear. The quality implies foresight, no less than insight, and it is revealed in practical politics, no less than in scientific theory. It is also the characteristic of French statesmanship as well as of French thought. Nowhere is this *clairvoyante volonté* of a nation more practically demonstrated than in the attitude of the State to science, and in the relations between the spheres of government and of knowledge.

France recognises clearly the fact that a nation depends on its science; that its commerce, its industries, its education, all its sources of wealth and of character, are to be found alone in a living and growing material of experimental knowledge. And the nation translates this recognition into will.

In the *Revue Scientifique* of September 23 there is an article by M. A. de Foville, permanent secretary of the French Academy of Moral and Political Sciences, which may well stir envy in an English mind, and prove once more that they manage these things so much better in France. M. de Foville gives a sketch of the Government department known as the "Caisse des recherches scientifiques," which was instituted in 1901, and now celebrates its decennial anniversary merely by modestly directing the attention of capitalists to its existence. The Caisse owes its institution to M. Audiffred, now a member of the Senate; its object, to quote his words, is "to endow all the sciences with adequate means; to ensure that no serious investigator shall be hindered in his work by lack of the funds necessary for research." It is attached to the Ministry of Public Instruction, but is actually autonomous. It is not, as M. de Foville observes, a charitable institution, but a State Treasury for scientific research. It has a very strong technical committee, which decides upon the applications sent in, and sends its recommendations to the administrative committee. The latest volume of specifications and results of researches financed by the Caisse contains 800 pages. The researches financed or assisted hitherto are distinguished by their eminently social and racial importance, being chiefly concerned with the purification of water supplies, and the methods of combating tuberculosis, syphilis, and other scourges.

The following grants were made in 1910:—1200*l.* to Dr. Calmette; 600*l.* to M. Riolle, for researches into the purification of water supplies; 420*l.* to the late Prof. Arloing, for researches into the prophylaxis of tuberculosis; 400*l.* to Dr. Calmette, for the same purpose; 120*l.* to Prof. Courmont, for studying the prevention of cancer; 120*l.* to M. Gaston, the prophylaxis of syphilis; 120*l.* to Prof. Gley, immunity against toxic serums. Besides these sums, nearly 5000*l.* was allotted to various researches, the total being nearly 8000*l.*, distributed thus:—Biological research, 4692*l.*; water supplies, 2460*l.*; other research, 480*l.*

This Government bureau is not managed by "permanent officials"; its council, consisting of well-known men of science, heads of industrial and commercial firms, and some politicians, is honorary. The

expenses of the department in 1910 were exactly 190*l.*! This last detail is one of the most instructive facts in the whole business.

The receipts of the Caisse in 1910 amounted to 18,000*l.* Its income is derived thus: the greater portion is allotted annually by the State from the State revenue as part of the National Budget; this averages about 8000*l.* Investments of capital bring in an increasing sum. Lastly, there are bequests, subscriptions, and gifts, from corporate bodies, societies, and individuals. This last source naturally fluctuates. In its ten years' history the Caisse has distributed 56,000*l.*, of which 36,000*l.* was allotted to biological researches, and 16,000*l.* to investigations and experiments connected with the purification of water supplies.

M. de Foville points out that the financial needs of science increase with the scale of scientific operations and with progress generally, and recommends the Caisse as a channel for private donations which has the advantage of imposing no restrictions or death-duties on bequests made to its funds.

France is also to be congratulated on possessing a society, *de Secours des Amis des Sciences*, the object of which is to aid men of science and inventors who are in material difficulties, and to relieve their widows and children from destitution. Founded by Baron L. J. Thenard in 1857, the society has distributed up to the present time more than 95,000*l.* (not a million pounds, as the *Athenaeum* of October 14 states). Prof. G. Darboux makes an eloquent appeal on its behalf to those who, like great industrial and commercial capitalists, owe so much to science, pure and applied. He points out that as the number of engineers, chemists, naturalists, biologists, and inventors increases, the risks increase proportionally, and the numbers, both of martyrs of science and of victims of *la misère*, with them. Charity of this kind, to those who have assisted to *prevent* human suffering, is, as the founder of the society remarked, "a work of reparation and of social justice."

England has only the precarious and arbitrary awards of the Civil List. The French charitable society is a complementary institution to its State aid of research. In it there is a channel for the charitable impulse, more humane and more patriotic than many of the usual forms of relief of destitution. As for the Caisse des recherches scientifiques, France has practically instituted (and the institution will grow) the Establishment of Science. In this is the Erastianism, and a sound Erastianism, of the future.

A. E. CRAWLEY.

FACTS OF MIGRATION.[1]

FOR learned and unlearned alike there is a peculiar fascination in the migrational movements of birds, and the more we know about them the more the wonder grows. The problems now clearly discerned will probably afford material for several centuries of inquiry, and there are others which we have not yet learned to state. In all such cases it seems to be in accordance with sound scientific method that we should tackle the more tangible problems first, that we should accumulate facts on all sides, and that we should pursue different paths of inquiry in the hope that their convergence may lead us to discovery. That we should occasionally relieve tension by flying a speculative kite will do no harm to anyone.

Of the various paths of inquiry three stand out prominently, and as each is not only theoretically reasonable, but has already led to something definite, it is gratuitous to pit one against another when more than all are needed. First, there is the method of registering the arrivals and departures, the changes and movements, in a small area, like Helgoland or Fair Island, which can be thoroughly explored. Second, there is the method of marking large numbers of migrants with indexed aluminium rings, in the hope of hearing again of the whereabouts of a small percentage. How this method has already led to the marking out of a more than provisional migrational-route for the white stork is well known. Third, there is the method of collecting data, year after year, from observers scattered over a wide area, both inland and on lighthouses and lightships, who record times of arrival and departure, great wave-like incursions, marked increase and decrease in numbers, and the like.

It is this third method which has been followed with praiseworthy persistence during the past six years by the British Ornithologists' Club, the facts reached being recorded in a series of reports, of which the sixth is now before us. What we have we are grateful for, and we would claim recognition for the industry and patience which the preparation of these reports has demanded from the members of the Migration Committee of the club, from the editor, Mr. W. R. Ogilvie-Grant, and from the large body of observers throughout the country. It is no disparagement, however, to point out that the report has scarcely as yet got beyond the raw materials of science. As the introduction states emphatically enough:—"When these investigations were first undertaken it was decided that they should be carried on over a period of ten years before any attempt was made to generalise, or draw deductions from the facts collected."

In the introduction a reference is made to a notice of last year's report (NATURE, March 9, 1910), in which a reviewer suggested (among other things) that a systematic "ringing" of the birds at the light stations would probably produce good results. To us also this seems a good suggestion, and the members of the committee are theoretically of the same mind. We regret to see, however, that they regard it as "quite impracticable." "We owe much to the courtesy of the Elder Brethren for allowing their keepers to fill in our schedules, but the latter could not be expected to 'ring' birds, nor is it to be expected that the authorities would allow unofficial observers to remain at the lights during the migration-season." We wonder, however, whether the difficulties are insurmountable. If so, it is a great pity. The lights are strategic points, the number of birds that might be "ringed" is often large, and a little "ringing" might save some of the keepers from life-harming heaviness.

The arrival of our summer migrants began in 1910 on March 5 (with the chiffchaff), but it proceeded slowly through that somewhat exceptionally fine month. Except in the case of a few species, the immigration did not begin until April 2, and continued until May 23. After that there was little movement observed, but a few species were unusually late (most of May was cold, inclement, and wet). The main body of spotted flycatchers did not arrive until June, and in some places sedge-warblers had not reached their breeding haunts by May 13. It will be very interesting to compare the data for 1910 with those for the extraordinarily fine summer of 1911, and it

[1] Bulletin of the British Ornithological Club, edited by W. R. Ogilvie-Grant. Vol. xxviii. Report on the immigration of summer residents in the spring of 1910: and also notes on the migratory movements and records received from lighthouses and light vessels during the autumn of 1909. By the Committee appointed by the British Ornithologists' Club. August, 1911. Pp. 313. Many maps. (London: Witherby and Co.) Price 6*s.*

may be that the final comparison of year with year will furnish a basis for conclusions which will justify the details and labour of these reports.

"The larger waves of migration were not very clearly marked, but there were smaller ones on April 12 and 13, and on May 15. The largest movement occurred on May 2, when no less than twenty-five species arrived simultaneously on our coasts." If these facts are really significant, we naturally wish to see whether they are correlated with weather conditions, and the report, like its predecessors, gives us facilities for speculation on this subject by giving a meteorological summary for each day. Special attention has been paid to the conditions observed over the north coast of Spain, the Bay of Biscay, the coast of France, bounding the Bay, the English Channel, and our southern shores. But the report remains firm in affording us neither countenance nor aid in this speculation. We must wait until the ten years are accomplished before there is any relaxation in the conspiracy of silence, which is a thoroughly scientific procedure.

In saying a moment ago, "if these facts are significant," we were not indulging in a superiority of tone begotten of our own enlightenment on the subject; we simply mean that in the long run the question must be faced whether the net of observation is spread sufficiently widely, and has mesh sufficiently narrow to warrant one in speaking very definitely of waves of different magnitudes, or, in some cases, of waves at all. It is difficult to get rid of the uncomfortable suspicion that what is recorded may be in many cases the exceptional, the normal passing unobserved because there is no one there to see. We wish, therefore, that a large addition to the body of observers throughout England could be secured, so that it might be seen whether a marked narrowing of the mesh is followed by any marked alteration in the general tenor of the records. It may also be that the detailed comparison of one year with another may afford an answer to our difficulty.

There are some interesting remarks in the introduction on the variable length of the immigration period. "The immigration of the wheatear (including both races) extended over a longer period than that taken by any other species, the first arrivals being observed on March 6, the last on May 19. Other species occupying a prolonged period were the willow-warbler (March 19 to May 19) and the whinchat (March 26 to May 23), while the shortest time seems to have been taken by the wood-warbler (April 11 to May 6). The average length of the arrival period for 1910 was about five or six weeks."

We may refer also to the provisional classification of the birds observed into four sets according to their general routes. (*a*) There are those that arrive *solely* on the western half of the south coast—ring-ouzel, pied-flycatcher, and landrail; (*b*) there are those that arrive along the *whole* of the south coast, but first and chiefly on its western half—wheatear, redstart, common whitethroat, garden-warbler, chiffchaff, willow-warbler, spotted flycatcher, swallow, house-martin, sand-martin, and swift; (*c*) there are those that arrive along the *whole* of the south coast, but first and chiefly on its eastern half—whinchat, black-cap, grasshopper-warbler, reed-warbler, nightjar, cuckoo; (*d*) there are those that arrive along the south-east coast, from Essex to Hampshire—nightingale, white wagtail, yellow wagtail, tree-pipit, red-backed shrike, wryneck, turtle-dove. This grouping is still, as we have said, provisional; but there is in it, so to speak, the bud of a generalisation. In some of the items of fact which form the body of the book, there doubtless lurks the beginning of a discovery.

THE POSITION OF TECHNICAL INSTRUCTION IN ENGLAND.

During the last six months or so there have been issued several reports which deal in broad outline with the position of technical instruction in England. The last annual report of the British Science Guild deals with the financial position of higher technical education and with the need for coordination and centralisation of our resources. Attention is directed to the close connection between scientific research and prosperity of national industries, which more and more closely follows the encouragement of scientific investigations. The report of the Imperial Education Conference contained a strong indictment by Mr. J. H. Reynolds, director of higher education for Manchester, of the lack of appreciation of science shown by many political and industrial leaders. The discussion at the Portsmouth meeting of the British Association Section L report on overlapping of educational work brought clearly into view the lamentable truncation of our secondary education, which fails to provide, except in the case of a small minority of pupils, any adequate foundation for higher study of a proper university grade. The Board of Education has quite recently published statistics which emphasise the poor attendance of students at places of higher technical instruction. Readers of Nature are already aware of the main facts; unfortunately they are not sufficiently realised by the general public.

Present Shortcomings.

The essential features of the present position appear to be:—

(1) The low leaving age of secondary schools, and therefore the low standard of entrance into technical schools. The average school life in our secondary schools does not exceed three and a half years, whereas German technical universities require the completion of the full nine years' secondary-school course before admission of fully qualified students.

(2) The preponderance of evening work in English technical institutions. A few evening students are doing amazingly good work under very difficult conditions; but however creditable this may be, and indeed is, to these overworked men and their teachers, it does not seriously affect the following statement in the latest Board of Education report:—"The total amount of advanced instruction of the kind provided in technical institutions is still disappointingly small. In some of the more important industries, as, for example, engineering, the instruction is largely used by students; but in a great many others the supply of students is very small. It is to be deplored that there are several schools in which the well-equipped staffs and the excellent equipment practically stand idle in the daytime through lack of students." There are no evening students at German universities.

(3) The majority of evening students are doing work of a continuation-school character; moreover, for many of them regular attendance is impossible.

(4) Speaking generally, technical teachers are underpaid to a degree which in the long run will surely result in impaired efficiency. Incidentally it may be remarked that the value of the annual production of the German chemical industries alone is about 50,000,000*l.*, so that the expenditure by Germany of half a million per annum in excess of England's provision for higher technical instruction yields a good business profit.

(5) Taking the relative populations into account, England stands below the United States, Germany, and Switzerland as regards the training and output of industrial experts having the highest scientific and

technical knowledge. Writing as a chemical manufacturer, Dr. Levinstein warns us against "thinking that we can replace efficient captains by a large number of fairly good corporals."

Interaction between Instruction and Industry.

It will have been observed that engineering holds the best position in the Board of Education review, from which we have quoted, dealing with the technical instruction of the United Kingdom. It is not by accident that British engineers are found all over the world. Any advance in an industry leads to wider and more intense study, to greater demand for instruction, and a consequent improvement in its quality. The loss of the chemical dye industry is frequently attributed to lack of knowledge on the part of English manufacturers. It appears more probable to the writer that the high duty on spirit stifled the industry in its cradle; the loss of the manufacture removed the incentives (moral as well as pecuniary) to study and research from this country, and transferred them to Germany. How the rise of this new German industry promoted study and research into coal-tar derivatives, how this research developed the industry yet farther, and how this reciprocity of industrial and instructional progress has helped the industrial advance of Germany is a story that needs no repetition. But it is still necessary to drive home the importance of close connection between our technical instruction and our industries, and to remove the lost traces of antagonism between the "practical man" and the "theoretical person."

When college training was a new thing, it was to be expected that some of the young men should imagine that their up-to-date theoretical knowledge made them better engineers than their experienced seniors; but such youthful conceit soon finds its Nemesis. By this time many of the managers in engineering works have themselves been through a college course, and the recruit with the ink scarcely dry on his diploma finds his proper level at once. With the realisation of what a college course can, and what it cannot, do towards making a real expert, we may expect an absence of friction and misunderstanding, and the establishment of a right appreciation of college training. There can be no doubt that the United States has profited greatly by not undervaluing courses of study pursued in university institutions. It should not be overlooked that an increase in the number of such trained men raises the status of the nation as a whole. In 1897 there were found to be 7000 chemists trained in Germany holding responsible positions, of whom one thousand were employed in other countries. Deducting another thousand employed in the manufacture of organic compounds—*i.e.* assuming that we do not wish to challenge Germany's supremacy in this department—is it likely that we have 5000 chemists of first-grade qualifications who have been trained in England? It appears probable that we are more nearly forty than fourteen years behind in this respect. The potentialities of our technical institutions are not properly appreciated by chemical manufacturers, and the interaction between industry and instruction is not so free and constant as is requisite for full industrial health.

Some Suggestions towards a Constructive Policy.

A preliminary step would be the limitation of the application of the epithet "technical." The Board of Education should confine the designation "technical institution" to establishments of really advanced staffing and equipment. Elementary classes doing the work of repairing defects in school education should be classed as continuation classes; "technical class" should imply a serious attempt to impart knowledge and skill of a technological character. Stronger efforts should be made to improve the quality of the teaching, both in subject-matter and method, in elementary schools. No boy or girl should leave the elementary school (unless to enter a secondary or trade school) before the age of fourteen. Continuation classes should be available in every locality, as soon as suitable teachers can be obtained, and the recommendations of the Consultative Committee of the Board of Education should be put into practice. In particular employers should liberate young people for a certain number of hours per week in order that they may attend day classes. The leaving age from secondary schools should be raised, and the universities and university colleges should not admit students below eighteen years of age.

Based upon a proper school education in the elementary and continuation schools, trade schools, or secondary schools, evening instruction of great value could be given to the better workmen, foremen, and skilled craftsmen. Such instruction is already given in the polytechnics, in evening classes of university colleges, and in the smaller towns in the technical classes which are frequently styled "institutes." The higher grade of technical instruction should be carried out in the day classes of well-equipped institutions ranking as university colleges. The diploma of these institutes and colleges should deserve recognition as the hall-mark of a trained scientific man. Two years after obtaining his diploma, the holder should be permitted to present a research or thesis to the university, which should grant a degree for work of genuine merit. The approach to such a university degree should not be stopped by protective or revenue-raising barriers of the matriculation type. This demand is made with the idea of preserving the connection which at present exists between departments for higher applied science and the older and modern universities. The alternative would be the adoption of the German system of technical universities. It is by no means certain that these rapidly growing and in some respects very successful universities are models to be followed. There is at least a danger of over-specialisation in the German system—a tendency to produce machine-made men possessing a narrowly specialised knowledge and capacity, but without sufficient width and individuality. Our captains of industry have to control men, as well as to perfect processes.

In the plan roughly outlined above an attempt has been made to provide (*a*) technical education needed by the foreman, skilled artisan, &c., (*b*) technical education needed by the scientific leaders of industry. The former requires a large number of classes of a local character; the country should be peppered with such, and the financing and control should be to a considerable extent the duty of the local education authority. The latter should be large institutions, staffed by specialists, assisted largely by national funds, with centralisation as the dominant idea in their organisation. For both we need advisory boards, including employers and employees, also representatives of the teachers in the schools from which pupils are derived. Provision should be made for the passage of students of exceptional merit from the lower to the higher grade.

Further, it is highly important that greatly increased provision should be made for post-graduate research. Space and opportunity for this work and for carrying on monotechnical courses of an advanced type will be found by freeing the university colleges from the obligation to hold matriculation classes and by relieving our higher technical institutions from the necessity of teaching decimals.

Mr. Reynolds has reminded us that it was in 1869 that Scott Russell wrote "Systematic Technical Education for the English People" in order to "move the minds of English statesmen." Since that date we have nationalised elementary education, and the process of nationalising secondary education proceeds apace. Signs of further realisation of that national organisation of which Sir Norman Lockyer has long been an advocate are to be seen in the Minority Report of the Poor Law Commission and in the recent transfer to the Board of Education of the control of Exchequer grants to universities. The Continued Education Bill introduced by Mr. Runciman fails as a practical measure by reason of the absence of financial provision and of the too-early age for leaving school; but its introduction is welcome as evidence that educated public opinion calls for Governmental action. The London University Commission can scarcely fail to throw light on many of the difficulties which beset the subject. The proposed Teachers' Council will bring together in one national organisation teachers in universities, technical institutions, secondary and elementary schools. All these phenomena afford evidence of an awakening national spirit in matters educational, and the main purpose of this article is to urge all interested to bend their backs to the work of nationalising technical education. By so doing we may advance an important step towards the realisation of Scott Russell's ideal, viz. "to show how to form a nation of well-educated Englishmen, where each workman shall thoroughly know his work; where each foreman shall thoroughly understand the right principles and best methods of executing that work; and where each master of a manufactory, and each member of a profession, shall have received the highest education in the philosophical principles and modern methods of his art, science, or profession."

G. F. DANIELL.

ATOMIC WEIGHTS.

THE issue of the Proceedings of the Chemical Society for October 30, vol. xxvii., No. 390, contains the report of the International Committee on Atomic Weights for 1912. At the request of the society the committee wisely acceded to the suggestion that the annual report should be published prior to the beginning of the academic year in order that teachers and students during any given session may not be exposed to the possible inconvenience of having to deal with two sets of numerical values during their lecture or laboratory courses.

There is no doubt that the annual review of the state of contemporary knowledge respecting the values of the fundamental constants known as the atomic weights of the elements acts as a constant stimulus in securing the attention of workers to the importance of the subject; and the critical examination to which the various contributions to the more accurate ascertainment of these values is yearly subjected by the members of the committee tends to raise the standard of what should now be demanded as regards precision and validity of method. The consequence is that all the atomic weights of the commoner elements are now known to a degree of accuracy which stamps these values as among the best determined of all physical constants. They have been ascertained by a great variety of methods and by the use of a great variety of combinations in order to eliminate so far as possible the influence of constant errors. This is especially so in the case of elements such as oxygen, hydrogen, the halogens, nitrogen, carbon, sodium, potassium, silver, &c., which are themselves the bases upon which the determinations of the atomic weights of the other elements ultimately depend.

There is, however, still much to be done before the whole of the atomic weights of the eighty or so elementary bodies are known to this degree of accuracy. In a large number of cases, methods of obtaining suitable combinations of the elements have still to be worked out. It is not always easy to be sure of the purity, individuality, or constancy of composition of such combinations. Methods, too, of quantitative determination may be faulty, or may rest upon a doubtful basis. The efforts of chemists are therefore at the present time mainly directed to attempts to remove these conditions of uncertainty, since they constitute by far the chief sources of error—far greater, indeed, than any uncertainty due to the operation of weighing, for, thanks to the combined efforts of mechanicians and instrument makers, the modern chemical balance, intelligently and skilfully used, if not unsurpassed as an instrument of precision, is fully equal to the demands which modern atomic weights work, at least in its present stage of development, demands of it.

M. J. B. EDOUARD BORNET.

BOTANISTS will learn with regret that the death of the eminent phycologist, M. Edouard Bornet, occurred at Paris on December 18, 1911. Born at Guérigny in 1828, Bornet began by studying medicine, but early in his career turned his attention to cryptogamic botany, and under the direction of Tulasne and Léveillé devoted his energies to the study of algæ and lichens. On this subject, which he continued to pursue throughout his life, he published important papers and memoirs, whilst the garden at Antibes became during his supervision celebrated as a centre of phycological research.

Bornet's work was specially characterised by the care with which he unravelled the life-history of cellular plants, and in his numerous systematic papers the value of this fact is always apparent. His investigations in conjunction with Thuret on the fertilisation of algæ (especially of the Florideæ) were most valuable, and the two large volumes, "Notes Algologiques" and "Études Phycologiques" have been the admiration of all subsequent workers. Bornet also tackled the lichen problem, and the strong support which he gave to Schwendener's views as to the dual nature of these plants led to the early recognition of the accuracy of Schwendener's position. He isolated and specifically determined the algæ which enter into the composition of a large number of lichens, and described the method by which the hyphæ envelop the algæ, as well as the mutual benefit derived from the intimate association of the algæ and fungi. He came to the conclusion that every gonidium of a lichen can be referred to a species of alga, and that the connection of the hypha with the gonidia is of such a nature that it excludes the possibility of one organism being produced by the other. Amongst his systematic works the account of Schousboe's Mediterranean algæ and the joint revision with Flahault of the Nostocaceæ are the most important.

Bornet was "Officier" of the Legion of Honour, and was awarded the gold medal of the Linnean Society in 1891. In 1910 he was elected a foreign member of the Royal Society. British algologists often appealed to Bornet for aid in taxonomic questions, and always found correspondence with him a pleasure, not only on account of his characteristic thoroughness, but by reason of his appreciative interest and unfailing courtesy.

A. D. C.

NOTES.

THE lists of New Year Honours include three new peers, seven privy councillors, ten baronets, and forty knights. Among the honours conferred we notice the following:—*Baronet:* Mr. R. C. Forster, who is known in the scientific world by his generous gifts to the new chemical laboratories at University College, London. *Knights:* Prof. W. F. Barrett, F.R.S.; Dr. John H. Benson, president of the Royal College of Physicians, Ireland; Dr. Robert J. Collie, medical examiner to the London County Council and chief medical officer to the Metropolitan Water Board; Mr. J. Mackenzie Davidson, distinguished for his researches in X-ray work; Prof. Henry Jones, professor of moral philosophy in the University of Glasgow; Dr. A. B. Kempe, F.R.S., treasurer of the Royal Society; Dr. H. A. Miers, F.R.S., principal of the University of London since 1908; Dr. G. H. Savage, a well-known authority on mental diseases; Prof. E. B. Tylor, F.R.S., emeritus professor of anthropology in the University of Oxford; Dr. Bertram C. A. Windle, F.R.S., president of University College, Cork, which, until the Irish Universities Act of 1908, was designated Queen's College. *Companion of the Order of the Bath:* Dr. A. Newsholme, medical officer of the Local Government Board. *Companion of the Order of St. Michael and St. George:* Lieut.-Colonel David Prain, F.R.S., director of the Royal Botanic Gardens, Kew.

THE recent decision of Sir Samuel Evans (the President of the Admiralty Court) and Trinity Masters in the case of the *Hawke* and *Olympic*, that the accident was due to the influence of the latter on the former owing to the *Olympic* taking a too large turn coming into Spithead, is very interesting. The experiments carried out at the William Froude Tank at Teddington played an important part in the case, and have thrown considerable light on a subject which must necessarily come into prominence as the size and speed of vessels increase. These experiments took the form of the running of scale models of the *Hawke* and *Olympic* in the main experiment tank. Part of this had been fitted with a false bottom to give in the experiments the shallow-water effect that would be produced on the ships by the depth of water in which they were steaming. The models were run at the same speed, corresponding to eighteen knots for the *Olympic*, and at a fixed distance apart laterally, corresponding to 100 yards for the ships. In these circumstances, with the *Hawke* model quite free to move sideways or angularly, the experiments clearly demonstrated that in the shallow water the larger model did exert considerable influence upon the smaller, and that with the *Hawke* model in those positions where this influence became one of attraction at the bow and repulsion at the stern, these forces could not be overcome by the rudder even with considerably greater helm than the 15° which the *Hawke* had at the time of the accident. The canting tendency which occurs when one ship has partially passed another is far more difficult to overcome than the sheering (or bodily movement) tendency which occurs when the vessels are broadside to each other, and unless the overtaking vessel is going relatively fast enough to run ahead there is every chance of a collision.

ON the night of December 31, 1911, a large mass of the chalk cliff fell into the sea at Abbottscliff, west of Shakespeare Cliff, between Dover and Folkestone. The fallen rock now extends as a platform stretching 400 yards seaward, with a breadth of about 200 yards and a height in places of 30 feet. The aspects of the cliff and shore have been entirely altered. The noise of the fall appeared to the coastguard like the firing of heavy guns, and the inrush of this vast bulk of rock into the sea produced so much effect upon the height of the water that it caused considerable disturbance to the shipping in Folkestone Harbour. Falls in the winter time are by no means uncommon on this part of the coast. The outline of Shakespeare Cliff was much modified by an immense fall in 1809; others took place in the month of January 1905, 1907, and 1909. It is possible that the long drought of the past summer, followed by the heavy rains of the latter part of the year, may have hastened the recent landslip. The gradual desiccation of the ground has been very marked in many places, and it has had a serious effect on the stability of numerous buildings owing to the shrinking of the foundation soil through loss of moisture. The chalk cliffs have no doubt been affected in the same way; joints have been opened to an extent that would not occur in a normal year, thus providing more channels for the recent rains. Though the chalk cliffs present so uniform an appearance when observed from a distance, they are formed, in reality, of layers of variable physical character, a circumstance which greatly facilitates their downfall.

ONE of the great founders of the science of physical anthropology has passed away in the person of Dr. Paul Topinard. He was a pupil, colleague, and friend of the illustrious Broca, "a man who," Dr. Beddoe said, "positively radiated science and the love of science; no one could associate with him without catching a portion of the sacred flame. Topinard has been the Elisha of this Elijah." Topinard made valuable investigations on the living population of France, and many researches in various other branches of physical anthropology. In 1876 he published a relatively small book, "L'Anthropologie," for which he obtained a gold medal from the Faculté de Médecine de Paris, and a second prize from l'Institut; it was translated into English, and published in the Library of Contemporary Science in 1878. This book is packed with information, as it contains numerous measurements and an exposition of methods of investigation; it has long been a guide for students and a manual of reference for travellers and others. In 1885 he published his "Éléments d'Anthropologie générale," a monumental work of 1157 pages, being the substance of his courses of lectures and laboratory instruction for eight years in the École d'Anthropologie. It is not the compilation of a mere library student, but is permeated by the author's personality and contains the results of his very numerous and varied researches; in it he broke free from the traditions of the monogenists and polygenists, and incorporated the new ideas spread by Darwin and Haeckel. This great work exhibits his vast erudition and untiring energy, and it is indispensable for all physical anthropologists. It is needless to add that Dr. Topinard has gained honours in his own country and the homage of his colleagues all over the world.

WE regret to see the announcement, made in a Reuter report from Paris, that Mme. Curie is seriously ill with appendicitis, and has been taken to a hospital to undergo an operation.

PROF. ARMIN BALTZER, Berne, and Dr. Emmanuel de Margerie, Paris, have been elected foreign members of the Geological Society of London. Prof. Charles Depéret, Lyons, and Prof. Arvid Gustaf Högbom, Upsala, have been elected foreign correspondents of the society.

THE extension of the Horniman Museum, Forest Hill, consisting of a lecture hall and a new library, the gift of Mr. E. J. Horniman, son of the donor of the museum, will be opened on Saturday, January 27, by Sir Archibald Geikie, K.C.B., president of the Royal Society.

MR. A. F. HALLIMOND has been appointed to the assistant curatorship of the Museum of Practical Geology, in succession to Mr. W. F. P. McLintock, who has been transferred to the geological department of the Royal Scottish Museum, Edinburgh.

DR. GILBERT T. MORGAN, assistant professor of chemistry at the Imperial College of Science and Technology, South Kensington, and junior hon. secretary of the Chemical Society, has been appointed to the chair of chemistry at the Royal College of Science, Dublin, rendered vacant by the retirement of Sir Walter Noel Hartley, F.R.S.

AT the ordinary scientific meeting of the Chemical Society on Thursday, December 21, 1911, it was announced by the president, Prof. Percy F. Frankland, F.R.S., that the council had awarded the Longstaff medal for 1912 to Dr. H. Brereton Baker, F.R.S., and that the presentation of the medal would be made at the annual general meeting to be held on March 28.

THE Selborne Society has arranged a Christmas holiday lecture for children, to be given in the Theatre at Burlington Gardens on Monday, January 8, by Mr. Wilfred Mark Webb. Lord Montagu of Beaulieu will preside, and the subject will be "Punch and Judy." Tickets may be obtained through members or from the offices of the society at 42 Bloomsbury Square, London, W.C.

A SCARE has been caused in Berlin by the occurrence of a mysterious "epidemic." Within a couple of days or so more than a hundred individuals were attacked with serious illness presenting the same symptoms, and some sixty or thereabouts have died. The victims seem to be of the poorest class, and the outbreak is not confined to one locality. The information to hand is scanty, but suggests that the condition is one of ptomaine poisoning, or of epidemic food poisoning, due to the ingestion of unsound food. The latest report states that certain spirits sold for consumption have been found to contain a large proportion of methylated spirit, and attributes the illness to this, but is hardly credible, unless German methylated spirit is very different from ours.

A SUMMARY, issued by the Meteorological Office, of the weather for 1911 for the several districts of the United Kingdom, obtained from the Weather Reports for the fifty-two weeks ended December 30, shows that the mean temperature was above the average over the whole of the United Kingdom, and in most of the English districts the excess amounted to about 2°. The range of temperature was everywhere large, being 84° in the Midland counties, 81° in the east of England, and 80° in the south-east of England. The maximum shade temperature exceeded 90° in all the English districts, and was 98° in the Midland counties, whilst the minimum temperatures were below 20° over the entire kingdom, except in the Channel Islands. The rainfall for the year was generally deficient, but the heavy rains which fell in October, November, and December have everywhere lessened the deficiency, whilst in the south-east of England and in the Channel Islands the aggregate rainfall was in excess of the average. The largest measurement of rain for any district for the year was 51·04 inches, for the north of Scotland, and the largest in any English district was 30·82 inches, for the south-west of England. The least measurement was 22·04 inches, for the Midland counties, which is 4·20 inches less than the average for the past twenty-five years. In the north of Ireland the deficiency is 4·75 inches. In the south-east of England, which district embraces London, the rainfall for the year was 28·05 inches, which is 1·14 inches more than the normal. The rainy days were fewer than the average everywhere, except in the south of Ireland. The greatest frequency of rain was 227 days, in the north of Scotland; the least 159, in the south-east of England. The duration of bright sunshine was largely in excess of the average over the entire country; the greatest excess in any district is 336 hours, in the south-east of England. The absolutely greatest duration of sunshine was 2028 hours, in the Channel Islands, and the least 1257 hours, in the north of Scotland. In the south-east of England the sun shone for 1933 hours.

THE congress of the Royal Sanitary Institute will this year be held at York on July 29–August 3. The Archbishop of York will be the president of the congress. The business will be divided among ten sections, presided over as follows:—A, sanitary science and preventive medicine, Sir Shirley F. Murphy; B, engineering and architecture, Mr. J. Walker Smith; C, domestic hygiene, Mrs. Edwin Gray; D, hygiene of infancy and childhood, Mrs. M. Scharlieb; E, industrial hygiene, Sir Thomas Oliver; municipal representatives, the Lord Mayor of York, Mr. Ald. N. Green; medical officers of health, Prof. A. Bostock Hill; engineers and surveyors to county and other sanitary authorities, Mr. A. F. Greatorex; veterinary inspectors, Prof. J. R. U. Dewar; sanitary inspectors, Mr. T. G. Dee.

IN another part of the present issue an account is given of grants which the Development Commissioners have made for forestry instruction and investigation in connection with the University of Edinburgh and the Edinburgh and East of Scotland Agricultural College. The Commissioners have granted the University a sum of 4500*l.* toward the erection of a new forestry building, 2000*l.* toward the equipment of the museums and laboratories, and 500*l.* a year for five years for an additional lecturer and assistant. In addition, the University and the Agricultural College have been promised conjointly an annual sum, for a period of years, for the rent and upkeep of a forest garden and an area of experimental plantations. We are glad that the claims of forestry and agriculture are receiving such generous treatment from the Commissioners. When the British Science Guild urged these claims upon the Board of Agriculture not very long ago, little consideration was given to the strong case then presented. The practical assistance now being afforded by the Development Commissioners to various departments of agricultural education and research suggests that the Guild's efforts to promote the advancement of scientific agriculture have not been in vain.

THE second Mendeléeff Congress of Pure and Applied Chemistry and Physics will be held in St. Petersburg on December 21–28 (January 3–10). These congresses were originated by the Russian Physico-Chemical Society as a suitable means of perpetuating the memory of Mendeléeff and other notable Russian chemists, and are organised by the society; the first congress was held in 1907. Anybody interested in chemistry and physics may become a member by paying a fee of five roubles. The executive committee of the present congress consists of about fifty members; its president is Prof. Borgman, and vice-president, Prof. Favorski (the honorary president, Prof. Beketoff, died on December 1). Local committees have been formed in twelve towns. The following are the sections and subsections of the congress:—(1) pure chemistry; (2) technical analysis; (3) metallurgy and metallography; (4) applied electrochemistry; (5) cement and glass;

(6) pharmaceutical, forensic chemistry, and bromatology; (7) biological and agricultural chemistry; (8) hygiene; (9) pure physics; (10) geophysics; (11) seismology; (12) astrophysics; (13) applied physics; (14) wireless telegraphy; (15) aërodynamics; (16) methods of teaching physics and chemistry. The meetings will be (a) sectional; (b) several sections combined; (c) general, where reports on the recent progress of chemistry and physics will be read. Up to the present time eight general reports and about seventy papers for the sectional and united meetings have been announced. Many excursions to the institutes and colleges of St. Petersburg, and to chemical and engineering works, have been arranged; there will be also an exhibition of new chemical and physical apparatus. Some hundreds of members from all parts of Russia have already announced their intention to attend themselves, and their numbers, owing to the attractions of the capital, will probably be as large as at the first congress.

THE council of the London School of Tropical Medicine has decided to establish a journal in connection with the school. Three parts are to appear each year, and part i. has just been issued. Sir Patrick Manson writes a foreword; original papers are contributed by Drs. Bayon, Daniels, Hutton, Leiper, Minett, and Wise; and surveys of recent literature on tropical medicine and reviews of books complete the matter.

A SERIES of studies of the motions of flagella of microscopic organisms observed by means of the ultra-microscope is contributed by V. Ulehla to the *Biologisches Centralblatt* (xxxi., Nos. 20–23). Interesting observations have been made on monads, bacteria, algæ, Euglenia, &c. In some cases when two flagella are present one revolves round the other. A classification of types of flagella and of flagellar movement is given.

THE report on the health of the Army for the year 1910, recently issued, contains matter of much interest. The health of the troops at home and abroad was better last year than ever before, and this applies to the admissions to hospital, deaths, invalids sent home, and the constantly sick; only in invalids finally discharged is there a fractional rise. Loss or decay of many teeth has caused the largest number of rejections of intending recruits, and venereal disease accounts for the largest number of the total inefficiency from sickness. In the Mediterranean stations there were only two admissions for Mediterranean fever in Gibraltar and one in Malta (out of an average strength of 6769), the latter a young officer just arrived who drank unboiled milk, probably goat's milk. There was an increase in malaria in Jamaica and West Africa, and a diminution in India, over the average for the previous five years. Venereal and tuberculous diseases have almost everywhere decreased as compared with the average of the previous five years, and there has been a welcome and remarkable diminution in enteric fever among the European troops in India.

THE second part of vol. ii. of the Museum Journal of the University of Philadelphia is devoted to a survey of New Zealand culture, based on the great collection made by E. W. Clark, the most important addition contributed in recent years to the museum. It includes splendid specimens of wood-carving, tail pieces of canoes, house posts, paddles, wooden staves, dancing clubs, and wooden boxes. In addition, we have clubs of polished whalebone, a chief's club in green jade, and a good example of the Heitiki, recognised by Captain Cook and other early travellers as the characteristic personal ornament of the Maoris. It is much to be regretted that this remarkable collection has not found a home in one of our imperial or colonial museums.

MR. C. B. MOORE, in a paper entitled "Some Aboriginal Sites on Mississippi River," contributed to vol. xiv., part iii., of the Journal of the Academy of Natural Sciences, Philadelphia, describes a number of Indian burial mounds along the course of the river. It is well that this survey has been undertaken, because many of these monuments are being destroyed by changes in the course of the stream or by agricultural operations. The discoveries throw little light on the age of the makers or on their death cult. The pottery is interesting, particularly some representations of animals like the tortoise and raccoon, and some human figures are represented sitting cross-legged, a very unusual position in the statuettes discovered in this region.

IN *The National Geographic Magazine* for November, Mr. J. E. Pogue, of the United States National Museum, describes the remarkable "Rainbow" bridge of natural formation in the Navaho reservation near the south-east corner of Utah. This towering arch, of rainbow shape, spans the canyon, the geological formation of which is a buff-coloured, fine-grained sandstone, brick-red on its surface and stained with vertical streaks of a darker shade. It hangs 309 feet above stream-bottom, and the abutments stand 278 feet apart. The causeway, upon which an observer can be lowered from an adjacent cliff, the sides of which are too steep to admit easy passage, is 33 feet wide by 42 feet thick at the keystone point. These figures, however, give only a faint idea of the majestic symmetry of this remarkable structure. It was visited by white men for the first time in 1909. It is satisfactory to learn that the United States Government has constituted it a national monument, and has taken adequate measures for its preservation.

THE Schweich lectures on Biblical archæology, held under the auspices of the British Academy, were delivered last month by Prof. R. A. Stewart MacAlister, late director of excavations of the Palestine Exploration Fund, who discoursed on the "Philistines, their History and Civilisation." Prof. MacAlister dwelt on the earliest known history of the Philistines, on their supposed origin in Crete, and on their raid into Egypt. The earliest references to them in the Old Testament, and details of the capture of the Ark and of its wanderings among the people, were given. The lecturer traced the growth in power of the Philistines during the reign of Saul, referring to the outlawry of David and to his relations with the King of Gath, and also to the battles between David and the Philistines. By these battles their power was broken, and they almost disappear from the Biblical records. Facts relating to them contained in the Assyrian records from the eighth and seventh centuries B.C., and instances of their traditions among the modern peasants of Palestine were given. Referring to the political and military organisation of this people, Prof. MacAlister stated that they had the oldest form of oligarchic government on record. At present we are very ignorant of their language, only a few proper names and some doubtful words being known. But little has been ascertained of their religion, the two chief deities being the fish-shaped goddess Atargatis and the god Dagon; the cult of this latter deity long survived in Gaza, where he was worshipped under the name Marna. As to the arts, they had reached a comparatively high level; witness the various jewels, pottery, and bronze mirror which were found in the five tombs recently discovered at Gezer. It is probable, indeed, that

the alphabet was developed out of the Cretan linear script by this people.

A LARGE portion of vol. cxx., part vi., of the *Sitzungsberichte der k. Akad. der Wissenschaften* is occupied by a continuation of the accounts of the results of a recent survey of the plankton of the Adriatic. In the first paper Dr. A. Steuer discusses the amphipod crustaceans, describing a new species of Glossocephalus. The same naturalist also undertakes the stomatopod crustaceans and pteropod molluscs, while the tornarian and actinotrochan larvæ fall to the share of Dr. G. Stiasny.

ACCORDING to the report of the trustees for the year 1910–11, the details of the reorganisation of the Indian Museum have been worked out during the period under review, and the various sections of the collection handed over to the officers who will in future be respectively responsible for their preservation. Owing to the appointment of two additional officers, special progress has been made in the zoological section, both in regard to the arrangement and display of the exhibition series and in original research.

IN *The Zoologist* for December, 1911, Colonel C. E. Shepherd continues his account of the pharyngeal teeth of fishes, dealing in this instalment with those of the sea-breams (Sparidæ) and wrasses (Labridæ). Many members of each group feed on hard-shelled molluscs, and therefore require special crushing apparatus. Sea-breams effect this by the development of powerful molar-like teeth in the front of the jaws, and consequently require nothing special in the way of pharyngeals. The wrasses, on the other hand, rely solely on their pharyngeal dentition, of which the lower series forms a large plate resembling a cobbled road in miniature, while the upper is divided into two somewhat similar lateral patches.

THE distribution chart of a plant species serves not only to point out the areas occupied, but often throws light on its origin. These matters are discussed by Dr. C. H. Ostenfeld in a short pamphlet, with reference to seven species of Anemone, Hepatica, and Pulsatilla. It is unexpected to find that *Anemone nemorosa* does not extend to the western shores of Jutland, but, as would be expected, it grows further westward than *A. ranunculoides* and *Hepatica triloba*, which do not extend to the Atlantic coast nor yet to Great Britain. A curious feature is the mutually exclusive distribution of *Pulsatilla vulgaris* and *P. pratensis*. All the seven species are considered to be post-Glacial immigrants from the south.

THE biometrical investigations on the egg of the domestic fowl, carried out during the past four years at the Maine Agricultural Experiment Station, have necessitated the designing of methods for the accurate measurement of the whole or parts of eggs. These are collected in a recent report by M. R. Curtis, and will be found useful by others working at the same subject. It is considered that the methods possess a considerable degree of accuracy, while at the same time they have the advantage of simplicity of manipulation.

THE third report on the experimental work of the Sugar Experiment Station, Jamaica, shows continued progress in several directions. The station was not popular at first, but has gradually gained the confidence of the planters because of the valuable results it has been able to achieve. Manurial trials have demonstrated that on many of the island soils phosphates are not required, but nitrogenous and potassic manures are effective and profitable in seasons of normal rainfall, though not in dry years. New varieties of cane have been brought out considerably better than those formerly grown. The fermentation problems connected with the production of rum are being successfully investigated by Mr. Ashby, who has selected certain yeasts of high efficiency and sent them out in pure cultures to the estates, in most cases with very satisfactory results.

THE November (1911) number of *Petermann's Mitteilungen* contains the numbers of families in different provinces of China according to the official report of the recent census of the Empire. For Peking and some districts the number of individuals is also given.

La Géographie for December, 1911, announces that, in consequence of the misunderstandings caused by the old datum of Bourdalouë being still used in some river systems when giving flood warning instead of the mean sea-level at Marseilles, the Ministry of Public Works has ordered that, within five years, all bench-marks must be referred to the normal datum of mean sea-level at Marseilles.

A SHORT account of the work of the Norwegian expedition which visited Spitsbergen last summer to continue the topographical and geological surveys which had been carried on in previous years is given by M. A. Hoel in the October (1911) number of *La Géographie*. Photogrammetric methods were largely employed, on account of the short time which was available. In spite of much unfavourable weather, the work accomplished enabled a very complete topographical map to be drawn of the region between Ice Fiord and Bell Sound, as well as a general geological map of the quadrilateral formed by the north and south sides of the Spitsberg, Wijde Bay, and Ice Fiord.

IN the December (1911) number of *The Geographical Journal* Captain Rawling gives some information bearing on the geological structure of that part of Dutch New Guinea which he traversed, supplementing that brought back by Dr. Lorentz, who penetrated to the ridge of the main chain further to the eastward. A summary is given of the explorations of Mr. E. C. Abendanon in the Central Celebes. During 1909 and 1910 he travelled extensively in this island, and succeeded in throwing considerable light on its geology. While the southern peninsula was found to be a folded region with regular folds running in a general north-west direction, there is no pronounced folding in the south-eastern peninsula. A large number of altitudes were determined, and the results obtained are considerably lower than earlier observations had indicated.

Symons's Meteorological Magazine for December, 1911, contains the fourth and concluding part (winter) of Mr. W. Sedgwick's interesting notes on the weather of the seventeenth century, from information given in the diaries of Evelyn and Pepys (see NATURE, November 11, 1911). For this period (December–February) the observations are more complete than for the other seasons. The recorded instances of snow are surprisingly few, being only mentioned in thirteen winters in the period covered by the diaries (1648–1703), and only three of these falls appear to have been exceptional. Prolonged or severe frosts occurred in about ten of the winters; that of 1683–4 ("Frost Fair") far surpassed any within living memory; coaches plied to and fro on the Thames as in the streets, and the severe weather extended even so far south as Spain. At least eleven very mild or wet winters occurred in Evelyn's lifetime. In short, the author concludes, when all the information is considered, it does not appear that cold winters were more frequent, or mild winters less so, than they have been in the last fifty years, or that the average severity of the winters was greater than at the present time.

We have received an interesting little booklet from the Silent Electric Clock Company, of 192 Goswell Road, with which is embodied the firm's latest catalogue and price-list. This booklet is worthy of notice, for it differs widely from the ordinary run of price-lists, inasmuch as it contains a complete description of this firm's system, a system which is based upon more than sixteen years' experience of a class of apparatus which the Silent Electric Clock Company has apparently brought to a wonderful degree of perfection, judging from the list of more than eighty recent installations which have been supplied, no doubt much to the satisfaction of the users, amongst which we notice several British, colonial, and foreign Government departments, home municipalities, schools, and railway companies. It is interesting to observe that every department of time-keeping is provided for: large and small clocks; turret clocks; clocks for use on shipboard, with automatic adjustments for diurnal longitudinal correction; clocks arranged to strike and chime electrically, both for household as well as for public installations; and also for ringing bells according to variable programmes; high-grade astronomical clocks, and master clocks arranged for automatic synchronisation by means of the daily signal distributed by the Post Office Telegraph Department from Greenwich Observatory. Any of our readers interested in electric clock systems should certainly send an inquiry to this firm.

During the spring and summer of 1910 the United States Naval Wireless Laboratory carried out an extensive series of experiments on the range of communication by wireless telegraphy between two cruisers and the Brant Rock station, near Boston. An account of the work done and the results obtained is given by Mr. L. W. Austin in the October (1911) number of the Bulletin of the Bureau of Standards. The antenna of the Brant Rock station was 420 feet high, and of the umbrella type; those of the cruisers were 116 feet, and of the flat top type. In each case the coupling between closed circuit and antennæ was loose enough to cause only one wave to be emitted. Over salt water the received currents are proportional to the sending currents and to the product of the heights of sending and receiving antennæ divided by their distance apart and by the wave-length used. In addition, they are subject to absorption, which in the daytime is expressed by multiplying the above by e^{-ad}, where d is the distance and a a constant the value of which varies inversely as the square root of the wave-length. During the night the absorption is too irregular to be represented by any formula. The above statements have been tested over the following ranges:—sending currents, 7 to 30 amperes; antennæ heights, 37 to 130 feet; wave-lengths, 300 to 3750 metres; distances up to 1000 miles.

Engineering for December 29, 1911, contains an illustrated description of a floating crane of exceptional size which is now in use at the Austrian Naval Dockyard, Pola, on the Adriatic. The crane is designed to deal with the heaviest weights in ship construction, and also, on an emergency, to raise sunken submarines. According to the specification, the crane had to be provided with two crabs, each having a lifting capacity of 120 tons, the crabs being so designed that both could be used simultaneously, especially for the lifting of submerged loads, in which case the rear crab has to work at a maximum distance of 5 feet from a line corresponding with the front edge of the pontoon, the front crab being close against it. Arrangements are made whereby the submarine can be raised sufficiently out of the water for rescuing the crew through the conning tower, when the necessary steps could be taken with more leisure for salving the submarine itself. The crane can be propelled afloat at a speed of about 3·4 knots. Under test, each crab was made to carry a load of 150 tons, the rear crab being at a distance of 5 feet, and the front crab at a distance of 47 feet 7 inches, from a line corresponding with the front edge of the pontoon.

In chapter xxxix. of his "Study of Bird Flight"—which is now appearing serially in the pages of *Flight*—Dr. E. H. Hankin discusses the cause of soaring flight. Two ancient theories are examined and rejected, *i.e.* that the soaring bird takes advantage of (1) ascending currents reflected upward from the walls of high buildings, &c.; (2) ascending currents or eddies caused by heat: for the reason, in the first instance, of personal observation to the contrary in the case of heavy birds, and, in the second, that soaring can in some conditions be impossible in the presence of heat eddies as well as in their absence, and *vice versa*. "There is no evidence whatever," says Dr. Hankin, "in favour of the view that the energy of soaring flight is derived from the kinetic energy of air in movement independently of the bird's wing." The conclusion drawn is that the energy used in soaring is stored up in the air in potential form, for which he coins the word "ergaer." On the question of the composition and decomposition of "ergaer," our author admits he knows nothing, but defends his theory as entirely scientific, merely advancing the opinion that "ergaer" is stored sun energy, and that "the air under the wing of a soaring bird is undergoing a change of the nature of a sort of continuous explosion." Later in the development of the idea we are asked to suppose a bird gliding into a patch of soarable air with its wings at full camber. In these conditions, the "pull" would no longer act at the centre of gravity and would no longer be the momentum, but would change to the tractive effect of soarable air on the cambered wing, and so would act on a level with the wings.

A copy of the January issue of his catalogue of second-hand instruments (No. 49) has been received from Mr. C. Baker, 244 High Holborn, London. The list contains particulars of nearly 2000 items, the majority of which will interest the astronomer and the microscopist. The instruments are guaranteed to be in adjustment, and are for sale or hire.

The twenty-eighth annual issue of "The Year-book of the Scientific and Learned Societies of Great Britain and Ireland" has now been issued by Messrs. Charles Griffin and Co., Ltd. This useful work of reference is a record, compiled from official sources, of the work done in science, literature, and art during the session 1910–11 by numerous societies and Government institutions. It is to be regretted that the summary of the proceedings of the British Association, given on pp. 10 to 23, refers to the Sheffield meeting held in September, 1910, and not to the Portsmouth meeting of last year. Since the whole of the titles of papers, reports, &c., presented at the Portsmouth meeting were available before the middle of September last, we suggest they might with advantage have been included, in addition to those relating to the 1910 meeting.

Errata.—The paper on "Momentum in Evolution" published in last week's Nature was by Prof. Dendy, and not Denny, as printed on p. 301.—We are asked to state that on p. 296, col. one, line ten, "a rubber ram" should be "an iron ram." The former words were given in the manuscript supplied to us, and were passed in proof by our contributor.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JANUARY:—

Jan. 4. 15h. 20m. Neptune in conjunction with the Moon (Neptune 5° 39′ S.).
,, 16h. 0m. Mercury stationary.
9. 9h. 0m. Venus in conjunction with Jupiter (Venus 1° 38′ N.).
13. 10h. 0m. Neptune at opposition to the Sun.
14. 17h. 57m. Jupiter in conjunction with the Moon (Jupiter 4° 6′ N.).
15. 5h. 26m. Venus in conjunction with the Moon (Venus 5° 51′ N.).
,, 10h. 0m. Mercury at greatest elongation W. of the Sun.
16. 4h. 0m. Saturn stationary.
,, 18h. 23m. Mercury in conjunction with the Moon (Mercury 5° 48′ N.).
18. 23h. 51m. Uranus in conjunction with the Moon (Uranus 4° 33′ N.).
20. 7h. 0m. Uranus in conjunction with the Sun.
27. 12h. 10m. Saturn in conjunction with the Moon (Saturn 4° 9′ S.).
28. 13h. 58m. Mars in conjunction with the Moon (Mars 0° 37′ S.).

MARS.—A telegram from Prof. Lowell, published in No. 4543 of the *Astronomische Nachrichten*, states that, on December 17, 1911, the old south snowcap on Mars had practically disappeared, and new spots were forming outside.

M. Jarry Desloges, telegraphing from the Sétif Observatory on December 16, 1911, states that on December 15 the south polar cap was veiled, and that Libya, which was grey at the beginning of the Martian afternoon, was white towards sunset; Deucalionis Regio, clear during the morning, became grey in the afternoon.

Four splendid photographs of Mars taken by Prof. Barnard with the Yerkes 40-inch refractor in September, 1909, are published on the frontispiece of the September-October (1911) Journal of the Royal Astronomical Society of Canada.

EPHEMERIDES FOR COMETS 1911*a*, 1911*f*, AND 1911*g*.—As the position of Wolf's comet (1911*a*) during the summer will be unfavourable for observation, it is important that observations should be made during the next few months, and for this reason M. Kamensky publishes an ephemeris, extending to April 7, in No. 4543 of the *Astronomische Nachrichten*; observations already made show that his fourth (K_4) system of elements needs but small corrections. It is hoped that observations will be secured, as they may clear up the question of the possible enfeeblement of the comet. The present position (January 4) is 21h. 41·1m., $-1°$ 55·5′, and the path lies nearly directly eastwards through Aquarius and Pisces; the magnitude is about 14·0.

Quénisset's comet (1911*f*) is still moving nearly directly southwards through Scorpio, and will soon enter Lupus: R.A. = 15h. 49·6m., dec. = $-31°$ 54·7′. In the ephemeris published by Dr. Ebell the magnitude is 8·3.

Beljawsky's comet (1911*g*) is also too far south for observation in these latitudes. Dr. Ebell's ephemeris shows it to be in Corolla, and its magnitude is estimated as 8·6.

A PECULIAR VARIABLE STAR.—The measures and light-curve of the variable star 232848 Z Andromedæ, published in Circular 168 of the Harvard College Observatory, show the light-changes to be unique among stars yet observed. For the last six years the magnitude has been nearly constant at 11·0, but in 1901 there was a great outburst, the magnitude becoming 9·2. Prior to that, since 1889 there had been considerable oscillations of magnitude between 11·5 and 9·7.

This star is $+48°$4093, mag. 9·5, and its variability was discovered by Mrs. Fleming in 1901, who, examining its spectrum of October 17, 1900, recorded it as "Bright lines. Nova or Var?" An examination of the spectrum plates by Miss Cannon shows that the spectrum is unlike that of variable stars, and resembles that of several new stars. On the best photographs it is seen to be like those of Nova Persei, No. 2, on April 12, 1901; Nova Geminorum on March 29, 1903; and Nova Sagittarii, No. 1, on April 21, 1898; it also resembles that of RS Ophiuchi on July 15, 1898, at or near the time of the remarkable outburst of light in that object.

In addition to the bright lines $H\beta$, $H\gamma$, $H\delta$, and $H\epsilon$, there is one at about λ 4688 which, Prof. Pickering suggests, probably corresponds with the bright band in the spectra of fifth-type stars.

THE PARALLAX OF THE DOUBLE STAR KRUEGER 60.—During the period August 29, 1907 to April 10, 1910, Dr. Lau employed the 10-inch refractor of the Urania Observatory, on fourteen nights, to measure the interesting double star Krueger 60. From these measures he derived a value for the parallax, which he now publishes in No. 4542 of the *Astronomische Nachrichten*. His result is $+0·22'' \pm 0·038''$, with a probable error from one equation of $\pm 0·129''$; earlier measures by Barnard, Schlesinger, and Russell gave, in the mean, the value $+0·25''$.

THE HEIGHT OF PERSEID METEORS.—Employing the parallax method, Dr. Philipp Broch has calculated the heights of the beginnings and ends of 102 meteor paths observed during the period 1823–58, and now publishes the results in No. 4541 of the *Astronomische Nachrichten*. For all the meteors he finds the values 130·0 km. and 96·0 km. for the mean heights at the beginning and the end of the flights respectively, the mean length of the paths being 72·5 km. Of this number fifty-eight were certainly Perseids, and for these he finds the mean values 133·1 km. and 95·5 km., respectively, for the heights, the mean length of path being 72·0 km.

THE LILLE OBSERVATORY.—In No. 4543 of the *Astronomische Nachrichten* M. Jonckheere gives notice that his observatory, L'Observatoire d'Hem, taking the name of the prefecture under whose patronage it is, is to be known officially as the Lille Observatory.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual meeting of the Academy of Sciences, held on December 18, 1911, the prize awards for the year were announced as follows:—

Geometry.—The Francœur prize to Emile Lemoine, for the whole of his work in mathematics; the Bordin prize to A. Demoulin, for his researches on triple orthogonal systems.

Mechanics.—The Montyon prize to M. Jouguet, for his contributions to thermodynamics and chemical mechanics, Captain Duchêne receiving a recompense (500 francs) for his mathematical study of the aëroplane; the Poncelet prize to M. Rateaú, for his work as a whole; the Vaillant prize (in equal parts) between Charles Doyère and Henry Willotte, for memoirs on the application of the principles of the dynamics of fluids to the theory of helices; the Vaillant prize to M. Liénard, for his memoir on the movement of an ellipsoid in a viscous liquid.

Navigation.—The extraordinary Navy prize between M. Doyère (1500 francs), for his study of the bending of a thin sheet or thin ring submitted to any forces whatever, H. Roussilhe (1000 francs), for his hydrographic work on the coast of Madagascar, M. Leparmentier (1000 francs), for his book on the calculations relating to inclined hulls, G. Simonot (1000 francs), for his memoir on the resistance of a cylindrical tube of infinite length submerged in water, Pierre Lemaire (750 francs), for his memoir on the theory of the gyroscopic compass, and E. Perret (750 francs), for his work relating to nautical astronomy; the Plumey prize to Robert Lelong (1000 francs), for his work on marine motors.

Astronomy.—The Lalande prize to Lewis Boss, for his star catalogue; the Valz prize to C. Rambaud, for the whole of his astronomical researches; the G. de Pontécoulant prize (increased to 1700 francs) to L. Schulof, for his researches on the theory of comets and on lunar tables; the Damoiseau prize (in equal parts) between M. Millosevich, M. Witt, and M. Lagarde.

Geography.—The Tchihatchef prize between M. de Schokalsky (one half) and M. Deprat and M. Mausery (one

half); the Gay prize to Paul Lemoine, for his geological work in the French colonies.

Physics.—The Hébert prize to M. Hemsalech, for his work on spark spectra; the Hugues prize to Ch. Féry, for his researches in physics, especially those dealing with the laws of radiation and the measurement of high temperatures; the Gaston Planté prize to Paul Janet, for his researches in electricity and magnetism.

Chemistry.—The Jecker prize between M. Darzens (500 francs), M. Fosse (250 francs), and M. Tiffeneau (250 francs), for work in organic chemistry; the Cahours prize (in equal parts) between Louis Hackspill and M. Richard; the Berthelot prize to André Wahl; the Montyon prize (unhealthy trades) to M. Tissot, for his apparatus permitting work in a poisonous atmosphere, an invention of especial importance in mines.

Mineralogy and Geology.—The Delesse prize to Albert Michel-Lévy, for his petrographical and stratigraphical work; the Joseph Labbé prize to René Nicklès, for his geological and practical work in connection with the discovery of the coal basin at Meurthe-et-Moselle; the Fontannes prize to M. Cossmann, for his palæontological studies; the Victor Raulin prize to Emmanuel de Margerie, for the whole of his geological work.

Botany.—The Desmazières prize to Camille Sauvageau, for his recent researches on the brown algæ; the Montagne prize is not awarded, but Jean Beauverie and Antoine Lauby each receive an encouragement of 500 francs; the de Coincy prize to E. Achille Finet, for his publications relating to orchids.

Anatomy and Zoology.—The Grand prize of the physical sciences to M. Anthony, for his memoir on the characters of adaptation to tree life in vertebrates; the Savigny prize to Ferdinand Canu, for his work on the Bryozoa; the Cuvier prize to L. Cuénot, for the whole of his scientific work.

Medicine and Surgery.—Montyon prizes to L. Testut and O. Jacob (2500 francs), for their treatise on topographical anatomy; to Alexandre Besredka (2500 francs), for his work on the mechanism of anaphylaxia; and to E. Cassaet (2500 francs), for his memoir on the diagnosis of posterior pericarditis.

Mentions of 1500 francs are accorded to Pierre Nolf, Emile Feuillé, and E. Sacquépée, and citations to Léopold-Lévi and H. de Rothschild, S. Mercadé, G. Faroy, L. Panisset; the Barbier prize to H. Guilleminot, for his memoir on fluoroscopic radiometry; the Bréant prize is not awarded, but prizes from the foundation funds are given to M. Auclair and Louis Paris (2000 francs), to M. Dopter (2000 francs), and M. Duvoir (1000 francs); the Godard prize to Jean Louis Chirié; the du Baron Larrey prize to H. Coullaud and E. Ginestous, for their work on the physiology and vision of shooting, Maurice Boigey receiving a very honourable mention; the Bellion prize is divided between M. and Mme. Victor Henri, for their studies on the action of ultra-violet light on toxins and micro-organisms, and M. Courmont and M. Nogier for their researches on the sterilisation of water by the ultra-violet rays; the Mège prize is not awarded, but a prize of 300 francs is awarded to P. Nobécourt and Prosper Mercklen; the Chaussier prize to M. Imfert.

Physiology.—The Montyon prize (experimental physiology) divided equally between Dr. Marage and Raoul Combes; the Philipeaux prize between Mme. Z. Gruzewska, for the whole of her work in physiology, and Maurice Piettre, for his researches on bile; the Lallemand prize to Henri Piéron, for his work on the memory, Maurice Brissot receiving a very honourable mention, and J. Lévy-Valensi an honourable mention; the Pourat prize is not awarded.

Statistics.—Montyon prize (1000 francs) to René Risser, and a mention (500 francs) to Charles Heyraud.

History of the Sciences.—The Binoux prize divided between Antonio Favaro and Edmond Bonnet.

General Prizes.—Berthelot medals to MM. Darzens, Tiffeneau, Tissot, André Wahl, Louis Hackspill, Richard; the Gegner prize (increased to 4000 francs) to J. H. Fabre; the Frémont prize to Charles Frémont; the Lannelongue prize between Mme. Cusco and Mme. Rüch; Wilde prizes to M. Stefanik (2000 francs) and A. Trillat (2000 francs); the Lonchampt prize to M. Mazé, for his researches in agricultural chemistry and bacteriology; the Saintour prize to Jules Drach; the Fanny Emden prize is not awarded, but encouragements are attributed to M. Ochorowicz (1000 francs) and M. Boirac (2000 francs); the Pierson-Perrin prize to (the late) Henri Pellat, for the whole of his work; the Petit d'Ormoy prize (mathematics) to Jules Tannery and (natural science) to M. Depéret; the Serres prize to L. Vialleton, for his researches on embryology and comparative anatomy; the Jean Reynaud prize to Emile Picard; the Baron de Joest prize divided between H. Mouton and Charles Tellier; the Leconte prize is held over to this year; the prize founded by Mme. la Marquise de Laplace to Georges Marie Antoine Perrin; the prize founded by Félix Rivot between Georges Perrin, François Walckenaer, Henri Terrisse, and Jacques Denis.

The Bonaparte Foundation.

Thirty-four applications for grants from this fund were received, and the eleven mentioned below received favourable consideration:—M. Hartmann (4000 francs), for assistance in his experimental researches on the elasticity of solid bodies; M. Alluaud (3000 francs), for carrying on studies of the Alpine fauna and flora of the tropical mountains Kilimanjaro, Ruwenzori, and Kenia; H. Barbieri (3000 francs), for pursuing his chemical studies on nerve substance; M. André Broca (3000 francs), for constructing an apparatus for the measurement of geodesic angles by the Borda method; M. Krempf (3000 francs), for completing his work on the biology of the coasts of Indo-China; M. Sollaud (3000 francs), for pursuing his researches on the Palemonidæ; M. Topsent (3000 francs), for the zoological study of the fresh water of Saint-Jean-de-Losne (Côte d'Or); MM. Buisson and Fabry (2000 francs), for the purchase of apparatus to enable them to pursue their researches on the distribution of the energy in the solar spectrum; M. Gaubert (2000 francs), to acquire the apparatus necessary to pursue his work on liquid crystals; M. Houard (2000 francs), to permit him to pursue in America his researches on the Zoocecidæ; and M. Moureu (2000 francs), to permit him to pursue his studies on the rare gases and their distribution in nature.

The total grants from the fund amount to 30,000 francs for the year.

FORESTRY EDUCATION AT THE UNIVERSITY OF EDINBURGH.

IN October, 1910, Mr. E. P. Stebbing, who had been appointed university lecturer in forestry the previous May, delivered an inaugural lecture in the University, taking as his subject "Forestry Education: its Importance and Requirements." Extracts from this lecture were printed in NATURE of November 10, 1910 (vol. lxxxv., p. 61). Mr. Stebbing directed attention to the three chief requirements of the department of forestry of the University. These he considered to be: (1) a forest garden; (2) more accommodation for museums and laboratories; (3) an increase in the forestry staff.

The University has been giving undivided attention to these three wants of the department, and the following statement, which has been issued by the University to the Press, places the present position of Edinburgh as a forestry educational centre clearly before the public.

During the past year afforestation questions and forestry education have been receiving considerable attention in this country. In a resolution on the subject, the Development Commissioners decided that their first grants with the object of furthering the progress of afforestation would be made with the object of improving the means of affording sound forestry education in the country.

In Scotland a lecturer in forestry was appointed so long ago as 1888 at Edinburgh University, and an annual course of lectures has been delivered since that date during the winter session.

A few years ago the Edinburgh and East of Scotland Agricultural College inaugurated a short course of evening lectures in simple forestry for working foresters and others. This course has during the past year been extended, and a month's course of simple forestry, forest botany, and forest entomology is now delivered in August at the Agricultural College.

When, a few years ago, it became evident that the question of afforesting a portion of the British Isles had developed into a matter of considerable public importance, Edinburgh again led the way, and instituted a degree of B.Sc. in forestry and appointed lecturers to deliver the special courses which the forestry student is required to take, such as forest botany, forest chemistry, forest engineering, and forest entomology.

The University did not, however, rest content with this. The demands made upon the resources of the department led to the recognition of the fact that provision was required for three additional objects:—

(1) A forest garden, including an area for the experimental formation of woods.

(2) Extensions of the present museum and the provision of laboratories.

(3) Additional lecturers on the University forestry staff.

During the past year undivided attention has been devoted, in collaboration with the Edinburgh and East of Scotland Agricultural College, towards the attainment of these objects.

The Development Commissioners were approached by the University Court and the governors of the Agricultural College, and their applications were received with sympathetic consideration by the Commissioners, and have been accorded generous treatment.

A sum of money has been promised annually for a period of years for the rent and upkeep of a forest garden and area of experimental plantations. This sum has been promised conjointly to the University and College, and the authorities of these two institutions have appointed a joint committee to supervise the management of the area.

The Development Commissioners, recognising the urgent need of additional room for the extension of the forestry department within the University, its museums, and laboratories, have granted the University a sum of 4500*l.* towards the erection of a new forestry building, stipulating that the University should provide a similar sum. The University Court has undertaken to provide this amount, or a larger one should it be required. The Development Commissioners have also made a grant of 2000*l.* towards the equipment of the museums and laboratories, the money to be spent during the next five years. The Commissioners have promised to consider a further provision for this object should such be required at the end of this period. It is expected that the erection of the buildings will be commenced in the coming year.

The instruction in forestry proper for the degree will remain in the University, and with the object of supplementing the staff of the department the Development Commissioners have granted a sum of 2500*l.* (500*l.* a year for five years) as a provision for the salaries of an additional lecturer and for an assistant in the forestry department. One of these gentlemen has been already appointed, and the second will be shortly added to the staff.

The above detailed explanation of the present position of Edinburgh with regard to education in forestry will show that both the University and Agricultural College have gone thoroughly into the matter, and have determined that every effort shall be made to give the best forestry education possible alike to the student wishing to graduate in forestry and to the working forester and woodman who wishes to improve his education by following the simpler forestry courses delivered at the Agricultural College.

TESTS OF PROPELLERS FOR FLYING-MACHINES.

A SERIES of important and valuable experiments are being carried out at Chalais-Meudon by MM. Legrand and Gaudard with the object of testing propellers, while actually in use, on a flying machine, and of studying the action of the air on planes in flight. The machine used is a biplane specially built for the purpose at the laboratory; the propeller in front is run off a 60 horse-power Renault motor; the planes are staggered; and the total weight, including the pilot, is 780 kilograms.

In order to study the action of the air on the propeller and planes of a machine in horizontal flight, the following details must be known:—(1) the thrust of the propeller; (2) the speed of rotation of the propeller-blade or of the motor; (3) the actual speed of the aëroplane as it would be in calm air; and (4) the angle of incidence of the machine. The way employed in these experiments is to take simultaneous and instantaneous readings of all these details by the aid of special apparatus connected electrically, so that the pilot can choose his own moment and take the readings by pressing a button. The method of obtaining the angle of incidence and the speed of the machine is particularly ingenious. It consists of photographing the angle indicator—a pendulum moving in oil—and the manometer recording the pressure of the air-flow. In this way observers are not required, and the factor of personal error is eliminated.

Experiments have already been made with two propellers, A and B, A having a diameter of 2·65 metres and a pitch of 2·10 metres, and B a diameter of 2·85 metres and a pitch of 1·70 metres. The motor gave out 62 horse-power at 1800 revolutions, which was its normal speed, but in the case of A the revolutions in flight went up to 1870, and in B to 1980. It was found that a considerable deformation of both propellers took place during flight by which the pitch was reduced equally on both blades of A by 350 mm., but unequally on B to the extent of 350 mm. on one and 270 mm. on the other, so that when B was used considerable vibrations were observed.

At a speed of 17 metres per second propeller A gave out 168 kilograms thrust when the angle of incidence was 9° 45′, and at a speed of 16 metres, when the angle of incidence was 10° 15′, the thrust was 160 kilograms. B, on the other hand, at a speed of 15 metres, when the angle was 11°, only gave a thrust of 153 kilograms.

In static tests, A gave 225 kilograms and B 245 kilograms. The experimenters, as an outcome of these preliminary tests, state that many of the modern propellers in use have too small a relation between their pitch and diameter to be really efficient.

Lieut. Saunier piloted the machine on its trials, making only short, straight flights when there was practically no wind.

NEW MICROSCOPIC OBJECTIVES AND ACCESSORIES.

WE have received from Messrs. Angus, agents for R. Winkel, of Göttingen, some of his later productions which include special features.

With regard to the objectives, they have been examined and reported on by Mr. E. M. Nelson,[1] whose authority on such matters is second to none, so we may content ourselves by referring to his statements relating to the special colour correction of the achromats which Winkel employs, especially as he introduces a history of the changes made in these corrections which is of great interest.

"Before the introduction of Jena glass, the outstanding secondary spectrum of the old English archromat consisted of claret, or port-red, and apple-green colours. This was always looked for by experts, and its presence was thought to denote perfect correction. About 1870 (or a year or so later) Tolles, in America, altered the correction, and produced some very fine object-glasses with a flaring bright red, or crimson, spectrum. I well remember seeing a *Podura* scale shown with one of these glasses, a very brilliant lens, and a strong diatom resolver; the exclamation marks shone out like rubies, whereas if they had been viewed through an English objective of that date (Lister formula) the exclamation marks would have been seen with a more purple tint, something like an amethyst.

"About 1886, when Jena glass was introduced, an entirely new set of phenomena appeared; pale glasses, and those which gave decidedly bluish tints—which any expert of those days would have unhesitatingly condemned—were found to be not only strong diatom resolvers, but also to give sharp and bright pictures. For a time, experts, until they had learnt the effect of the reduction of the secondary spectrum by these new corrections, were all at sea, and did not know where they were.

"To-day, there is in my cabinet one of these Jena glass semi-apochromats which has such a violent purple secondary spectrum that it can be seen even when a peacock-green glass is used, a more monochromatic fluid

[1] Journ. R. Micr. Soc., 1911, pp. 451–52.

screen being required to shut the blue part of the purple out![1] Yet this lens gives particularly sharp images, and is a very strong diatom resolver. Now, however, Herr Winkel has revived the American red corrections with Jena glasses. The result is excellent, for brighter, sharper, or, for their apertures, stronger resolving object-glasses will not be found. This red correction is peculiarly suitable, because a peacock-green glass screen turns red into black, and so makes a strongly contrasted image. When the *Podura* was first examined with the 1/7 of 0·85 N.A., for the moment it was difficult to exclude the idea that one of the American red objectives was not on the nose-piece."

The outstanding colour in the fluorite objectives is of the same red tint. In these, of course, the outstanding colour is less, and their definition leaves nothing to be desired.

"Complanat" is a new word coined by Winkel for a new set of Huyghenian eye-pieces which are strictly achromatic and have a perfectly flat field.

Messrs. Angus have also sent us Winkel's new form of screw micrometer. This is based on a suggestion of Koch's. A combination of scale and screw replaces the combination of screw and thread, giving a ready means of obtaining the exact measurement of objects subtending a number of divisions of the scale, the fractional part only of an interval having to be determined by means of the screw. In the instrument real or lateral displacement is measured to 1/500 mm., one turn of the screw travelling over two divisions of the scale, an arrangement which we think will be found inconvenient.

The microscope stand is a beautifully finished specimen of the Continental model; an extension of the horseshoe backwards would make it more stable. The graduation of the scales in the attachable mechanical stage, and its general finish, leave nothing to be desired; the old reputation of the firm for fine metalwork is still kept up.

We have also received from Messrs. Angus a microscope and objectives representing the latest productions of the eminent firm of Reichert, of Vienna, together with a catalogue. As was to be expected, both the optical and mechanical parts are of the highest excellence. In the catalogue the number of fluorite lenses employed in each apochromatic objective is stated. The apochromatic of N.A. 1·30 sent us is a magnificent lens with little trace of colour, and its definition does not break down under a power of 3000.

THE FLORA OF FORMOSA.

PREVIOUS to the acquisition of Formosa by Japan, in 1895, little was known of the vegetation of the mountains of the interior. Many European collectors had visited the island, but none had been able to penetrate the central range, on account of the hostility of the natives. The Japanese soon organised a Botanical Survey, and several botanists have been engaged in the investigation of the flora, the results of their labours having been published from time to time, mostly in English, with Latin descriptions of the novelties, and figures of some of the most remarkable plants. The forerunner was the "Enumeratio Plantarum Formosanarum," by J. Matsumura and B. Hayata, which appeared in 1906. This was followed in 1908 by Hayata's "Flora Montana Formosæ"; and the same author has now issued a bulky and important supplement.[2] As is stated on the title-page, Dr. Hayata worked out his collections at Kew, where he had the opportunity of studying numerous types of genera and species of Eastern plants first described by the Kew botanists.

This work and its predecessors are mainly statistical, descriptive, and pictorial, though publications on the economic botany of the island are not wanting. However, it is possible to extract much that is interesting in the composition of the flora. Taking Dr. Hayata's own figures, the "Enumeratio" comprises 1909 species, belonging to 701 genera and 153 families; and the present supplement brings the numbers up to 2660, 836, and 156 respectively. It should be explained that these figures relate to the flowering plants and ferns and their allies only. In nearly all its features and generic elements the flora of Formosa is essentially Chinese, with a very large number of peculiar species. In all probability the number of species existing is far from exhausted; but the very small generic endemic element is not likely to be much increased by future explorations. Excluding ferns, Forbes and Hemsley's "Enumeration of Chinese Plants" includes representatives of 159 families, so that there are nearly as many in the smaller area as in the large. The same fact comes out in comparing a county flora with that of the whole of England, for example. Although the mountains rise to upwards of 13,000 feet, there is no real alpine flora in Formosa, though many genera are represented that are common to temperate and alpine zones.

Of the Cupuliferæ, the genera Fagus, Alnus, Carpinus, Castanea, Castanopsis, and Quercus are represented, the last-named by thirty-two species. Salix is represented by several species; Populus absent. About five and twenty Coniferæ are recorded, including *Chamaecyparis formosensis*, *Cunninghamia Konishii*, *Juniperus morrisonicola*, *J. formosana*, *Picea morrisonicola*, *Pinus formosana*, *P. taiwanensis*, *Tsuga formosana*, and *Taiwania cryptomerioides*, all of which are supposed to be peculiar to the island. The last is a monotypic genus endemic in Formosa. Nepenthes is not known to occur, nor Pedicularis, whereas in China there are about 150 species of the latter.

Vascular cryptogams are evidently strongly represented, as already there are on record upwards of 300 species of ferns, about twelve species each of Lycopodium and Selaginella, and two species of Equisetum. Orchids number about sixty species, mostly small-flowered and inconspicuous. The foregoing totals are partly compiled from Takiya Kawakami's "A List of Plants of Formosa," published in 1910.

W. BOTTING HEMSLEY.

THE INDIAN SALTPETRE INDUSTRY.[1]

THE production of potassium nitrate in India is probably a very ancient industry, and at the present time, in spite of German competition, the export still amounts to about 20,000 tons per annum. As is well known, the potassium nitrate is extracted by natives from soil collected in the villages, where in all probability it has been formed by bacterial decomposition of the organic matter, with production first of ammonia and subsequently of nitrates. The chemical and bacteriological changes have not yet been studied, but the actual methods of extraction have recently been described by Dr. Leather and Mr. Mukerji in a well-illustrated bulletin issued by the Pusa Research Station.

The soil from which the crude saltpetre is extracted usually contains about 3 to 5 per cent. of pure potassium nitrate, although there may be as little as 1 per cent. or as much as 29 per cent.; chlorides and sulphates are invariably present as well. The soil is scraped together in small quantities and collected by a very low caste called "Nuniah" or "Lunia," who also carry out the extraction process. An earthen chamber, called the "Kuria" or "Kothi," is first made of wet mud and then allowed to dry; the floor of this slopes somewhat from back to front, where a hole is made at the lowest point for the escape of the nitrate liquor. Raised a few inches above the floor, and supported by a few loose bricks, is a false bottom made of bamboos and matting, on which the saltpetre earth is laid with the greatest care and so trodden in that no crevices shall exist. As a rule wood ashes are mixed with the earth beforehand. The filling-in process is stopped when the layer of soil is about 6 to 8 inches in thickness; a small piece of matting is then laid on the top, and water is poured in until about one inch lies on the surface of the soil. Several hours elapse before the water has percolated and begun to flow out from the hole. It usually emerges as a fairly concentrated clear solution, coloured brown by

[1] A delicate test for colour is the raphæ of a Cherryfield Rhomboides, when mounted in balsam, quinidine, or styrax.

[2] Materials for a Flora of Formosa. Supplementary Notes to the Enumeratio Plantarum Formosanarum and Flora Montana Formosæ, based on a Study of the Collections of the Botanical Surveys of the Government of Formosa, principally made at the Herbarium of the Royal Gardens, Kew. Journal of the College of Science, Imperial University of Tokyo, vol. xxx., 1911, pp. 471.

[1] "The Indian Saltpetre Industry." By J. W. Leather and Jatindra Nath Mukerji. Agricultural Research Institute, Pusa. Bulletin No. 24, 1911.

organic matter. The first runnings are put into a pan and further concentrated by exposure to the sun, or by boiling over a fire until a mixture of sodium chloride and potassium nitrate, with varying quantities of sodium sulphate and magnesium nitrates, separates out. This is sold to the refiner as crude saltpetre. The mother liquor is thrown on to the heap of saltpetre earth, the so-called factory, to which are also added the wet soil from the "Kuria" and the weaker solution of nitrates coming out in the later stages of the percolation, and requiring too much fuel to make further concentration worth while. After a time the heap can again be extracted, and so the process goes on perpetually. Fresh village earth is constantly being added, but no special additions of organic matter seem to be made.

At the refinery the crude saltpetre, the impurities of which are soil, sodium sulphate, sodium chloride, and magnesium nitrate, is added to a boiling mother liquor from a previous operation. This liquor, being already saturated with sodium chloride and sodium sulphate, only dissolves the nitrate. When the insoluble matter has subsided, the clear liquor is run into wooden vats, and on cooling deposits a good deal of potassium nitrate, that only requires to be drained and slightly washed to be ready for market. The insoluble material still contains some potassium nitrate, and is thrown out on to the factory heap of nitre earth, from which more nitrate is subsequently again extracted as before. The mother liquor cannot be used indefinitely for the purification of the crude saltpetre, but it is not wasted. When it becomes too impure for further use, it is concentrated to deposit some of the sodium chloride, and the final liquor is simply thrown on to the factory heap again. Whilst the extraction process is remarkably efficient, considering that it has been evolved by the natives themselves without outside help, the refinery process is admittedly wasteful, and various improvements are suggested by Messrs. Leather and Mukerji.

GEOPHYSICAL RESEARCH.[1]

TO write the history of the earth is a very different undertaking from writing the history of a people. In the latter case, a diligent seeker can usually find some ancient monastery where far-sighted historians of an earlier generation have collected the more important records which he requires, and placed them within reach of his hand. With the earth's history, which is the province of geology, it is another matter. The great globe has been millions of years in the making, and, except for a mere fragment of its most recent history, it has had neither a historian nor an observer. Its formation has not only extended over an almost incomprehensible interval of time, but we have no parallel in our limited experience to help us to understand its complicated development, and no system of classification adequate to the task, even of grouping in an orderly way all the observed rock and mineral formations with reference to the forces which moulded them. And even if we could correctly interpret all the visible rock records, we are still quite helpless to comprehend all those earlier activities of the formation period, the record of which is now obliterated.

To the student of the earth's history, therefore, the problem of gathering and ordering such a widely scattered and heterogeneous collection of effects and causes is one of somewhat overwhelming scope and complication. In the industrial world, a situation of this kind soon results in replacing individual effort with collective effort, in the organisation of a system of a scope more appropriate to the magnitude of the task. We are familiar with industrial organisation and the wonderful progress in the development of American industries which has everywhere followed it. We are also familiar with organised geological surveys and the success which has attended them in geological and topographical classification. But the idea of organising research to meet a scientific situation of extraordinary scope and complexity is still comparatively new. The very words science and research are still regarded as referring to something out of the ordinary, something to be withheld from the common gaze, to be kept hidden in a special niche, behind a mysterious curtain and served by priests of peculiar temperament and unpractical ideals. This is both disparaging to our good sense and prejudicial to the progress of knowledge. Scientific research is not a luxury; it is a fundamental necessity. It is not a European fad, but is the very essence of the tremendous technologic and industrial success of the last twenty years, in which we have shared.

Prof. Nichols, of Cornell, as retiring president of the American Association for the Advancement of Science, put the case in this way: "The main product of science (research) . . . is knowledge. Among its by-products are the technologic arts, including invention, engineering in all its branches, and modern industry." The idea of scientific research is therefore not less tangible than industrial development, or less practical; it is merely one step more fundamental; it is concerned with the discovery of principles and underlying relations rather than their application. This being true, research should profit as much from efficient organisation as industrial development has done, or even more.

Although this conclusion is making its way but slowly in American science, in geological research, where material must be gathered from the utmost ends of the earth and even from within it, and where nearly every known branch of scientific activity finds some application, there is a peculiarly favourable opportunity for organised effort which is already coming to be recognised. "So long as geology remained a descriptive science," says President Van Hise, of Wisconsin, "it had little need of chemistry and physics; but the time has now come when geologists are not satisfied with mere description. They desire to interpret the phenomena they see in reference to their causes—in other words, under the principles of physics and chemistry. . . . This involves cooperation between physicists, chemists, and geologists."

In a general way, physics, chemistry, and biology have already supplied working hypotheses which have been used by students of geology to help in the examination, classification, and mapping of the most conspicuous features of the exposed portion of the earth. The geologist has gone abroad and has studied the distribution of land and water, the mountain ranges, the erosive action of ice and of surface water and the resulting sedimentary deposits, the distribution of volcanic activity and of its products, the igneous rocks; or more in detail he has studied the appearance of fossils in certain strata, and has inferred the sequence of geologic time. The distribution of particular minerals and of ore deposits has been carefully mapped. Regions which offer evidence of extraordinary upheaval through the exercise of physical forces have been painstakingly examined, and so on through the great range of geologic activity. In a word, the field has been given a thorough general examination; but the manifold problems which this examination has developed, although early recognised, and often the subject of philosophical speculation and discussion, still await an opportunity for quantitative study. They are often problems for the laboratory and not for the field, problems for exact measurement rather than for inference, problems for the physicist and chemist rather than for the geologist. This is not a result of oversight; it is a stage in the development of the science—first the location and classification of the material, then the laboratory study of why and how much.

Certain indications have led us to believe, for example, that the earth was once completely gaseous and in appearance much like our sun. Indeed, it possibly formed a part of the sun, but through some instability in the system became split off—a great gaseous ball which has cooled to its present condition. The cooling probably went on rapidly at first until a protecting crust formed about the ball, then more and more slowly, until now, when our loss of heat by radiation into space is more than compensated by heat received from the sun. Obviously, the earliest portions of this history are, and must remain, dependent upon inference, but the formation of a solid crust cannot advance far before portions of it become fixed in a form such that further disturbance does not destroy

[1] Presidential address delivered at the 700th meeting of the Philosophical Society of Washington, November 25, 1911, by Dr. Arthur L. Day. Reprinted from the Journal of the Washington Academy of Sciences, December 4, 1911.

their identity. From this point the history of the earth is a matter of record, and can be interpreted if only we have sufficient knowledge of the mineral relations through all the stages of their development.

It must have been a very turbulent sea, the molten surface of our earth upon which the rocky crust began to form. The first patches of crust were probably shattered over and over again by escaping gases and violent explosions, of which our waning volcanic activity is but a feeble echo. If the earth was first gaseous, and the outer surface gradually condensed to a liquid, its outer portions at least must have been whirled and tumbled about sufficiently, even in a few thousand years (which is a very small interval in the formation of an earth), to mix its various ingredients pretty thoroughly. It has accordingly been hard to see just how it came to separate into individual rocks of such widely different appearance and character. Of course, the number of its ingredients was large. We have already discovered eighty or more different elementary substances in the earth, and there is an almost endless number of more or less stable compounds of these. The freezing of an earth is therefore different from the freezing of pure water, but the freezing of salt water offers a clue to the explanation of the way in which the earth solidified as we find it. When salt water freezes the salt is practically all left behind. The ice contains much less salt, and the remaining water relatively more salt than before freezing began. Applying this familiar observation to the supposed molten surface of the earth as it begins to solidify, we have a suggestion of order and reason in its separation into so many kinds of rocks.

Now it happens that in the recent development of chemistry much attention has been given to the study of solutions of various kinds, and a great body of information has been gathered and classified, of which our observation upon the freezing of salt water is a simple type. Still more recently (quite lately, in fact) it has occurred to many students of the earth that here lies not only the clue, but perhaps the key, to their great problem. If the individual components which are intimately mixed in solution separate wholly or partially in some regular way upon freezing—and nearly all the solutions which have been studied appear to show such segregation—we have a quantitative system which will probably prove adequate to solve the problem of rock formation, provided only that the experimental difficulties attending the study of molten rock and the complications imposed by the presence of so many component minerals do not prove prohibitive. This is a very simple statement of the point of view which has led to the experimental study of rock formation in the laboratory as a natural sequence to statistical study in the field.

Geophysics, therefore, does not come as a new science, nor as a restricted subdivision of geology, like physiography or stratigraphy, but rather to introduce into the study of the earth an element of exactness, of quantitative relation. It may include physics or chemistry, biology or crystallography or physical chemistry, or all of these at need. The distinctive feature of geophysics is not its scope, which may well be left to the future, but its quantitative character. The geophysical laboratory of the Carnegie Institution at Washington has entered upon some of the investigations suggested by this long preliminary study of the earth—the physical properties and conditions of formation of the rocks and minerals. The department of terrestrial magnetism of the same institution has undertaken another—the earth's magnetism; the German Geophysical Laboratory at Göttingen a third—the earthquakes; and these will no doubt be followed by others.

The first effect of calling exact science into consultation upon geologic problems is to introduce a somewhat different viewpoint. It has been our habit to study the minerals and the rocks as we find them to-day, after many of the causes which have had a share in their evolution have ceased to be active—after the fire has gone out. If we attempt to reconstruct in our minds the operations which enter into the formation of an igneous rock or of a body of ore, we must infer them from present appearances and environment. The experimental geophysicist, on the other hand, confronting the same problem, says to himself: Can we not construct a miniature volcano in the laboratory? Can we not build a furnace in which an igneous rock can be formed under such conditions that we can observe its minutest change? He proposes to introduce temperature-measuring devices and apparatus for the determination of pressure, to investigate the character of the surrounding atmosphere and the quantity of water vapour which may be present. He insists upon the chemical purity of every ingredient which goes into the furnace, and guards it carefully against contamination. In these various ways he will undertake to ascertain the exact magnitude of all the causes, both physical and chemical, which have been at work in his miniature rock-producer, together with the physical characteristics of the product.

A very practical question now arises: Can he do all this successfully at the temperatures where the minerals form? We must press this question and insist upon a satisfactory answer, for it is by no means obvious that the relations which the physicist and chemist have established at the temperatures of everyday life—energy content, density, solubility, viscosity, dissociation—will continue to hold when substances are carried up to a white heat. The substances, too, are different from those with which the chemist and physicist have been generally familiar. Instead of simple metals, aqueous solutions, and readily soluble active salts, we encounter silicates and refractory oxides, inert in behaviour and capable of existing together in mixtures of great complexity. We must therefore extend the range of our physics and our chemistry to a scope in some degree commensurate with the wide range of conditions which the earth in its development has passed through. Let us follow for a little the actual progress of such an attempt.

The first step is to provide the necessary temperatures. Obviously, the common fire-clay crucible and the smelter's furnace, with its brick lining, will not serve us here, for all these are themselves mineral aggregates. The charge, furnace lining, and crucible would go down together in a fall as disastrous as Humpty Dumpty's. But experiment has taught us that platinum crucibles, magnesia furnace tubes enclosing an electrically heated helix of platinum wire, and electric temperature-measuring devices, provide a furnace in which nearly all the important minerals can be successfully studied, which is not enough to melt zinc, silver, gold, copper, nickel, or iron readily, and where any temperature up to 1600° C. can be maintained perfectly constant, if need be, for several weeks. All these temperatures can be measured with no uncertainty greater than 5°. This equipment preserves the chemical purity of the mineral studied, and enables the temperature to be controlled and measured at every step of the experimental work. Or an iridium furnace tube and an iridium crucible can be substituted for platinum, the magnesia supports can still be used, and we have it in our power to go on to 2000° C., which is quite sufficient for all the more important minerals which we know.

The physicist has therefore found a suitable melting-pot, and means of ascertaining what goes on within the pot; but he at once encounters another difficulty. Nature has provided us with relatively few minerals of high chemical purity. If a natural mineral is chosen for experiment, however typical it may be, several per cent. of other minerals may be expected to be present with it, the effect of which is at present quite unknown. Now the first axiom of the investigator in a new field who desires to undertake measurements which shall have a real value is that the number of unknown quantities in his equations must not be greater than he can eliminate by his experimental processes; in other words, he must begin with conditions so simple that the relation between a particular effect and its cause can be absolutely established without leaving undetermined factors. Having solved the simple case, it is a straightforward matter to utilise this information to help solve a more complicated one. If we would therefore reduce the mineral relations to an exact science, which is our obvious purpose, it is necessary from the outset to prepare minerals of the highest purity and to establish their properties. Having obtained such a pure mineral type, it may be, and often is, in the power of the mineralogist and his microscope to determine, by direct comparison with its natural prototype, the kind and amount of effect actually produced in the natural mineral

by the one or more other minerals which it contains. We have therefore scarcely started upon our investigation before the need of an organised system is demonstrated: first comes the chemist, who prepares and analyses the pure mineral for investigation; then the physicist, who provides and measures the conditions to which it is subjected; then the mineralogist, who establishes its optical properties in relation to the corresponding natural minerals.

Having prepared such a mineral, of high purity and of known crystalline character, we can ascertain its behaviour at the temperatures which must have obtained during the various stages of earth formation. We can study the various crystal forms through which it passes on heating and the temperature ranges within which these forms are stable; we can also melt it and measure the melting or solidifying temperature. Another mineral, prepared with the same care and studied in the same way, may afterward be added to the first, and the relation of these two determined. If they combine, heat is absorbed or released; and this quantity of heat can be measured, together with the exact temperature at which the absorption or release takes place. If the mixture results in the formation of one or more mineral compounds, we shall learn the conditions of formation, the temperature region within which the new forms are stable, and the changes which each undergoes with changes of pressure and temperature, as before. If the new forms show signs of instability, we can drop them into cold water or mercury so quickly that there will be no opportunity to return to initial stable forms, and thus obtain, for study with the microscope at our leisure, every individual phase of the process through which the group of minerals has passed.

Without complicating the illustration further, it is obvious that we have it in our power to reproduce in detail the actual process of rock formation within the earth, and to substitute measurement where the geologist has been obliged to use inference; to tabulate the whole history of the formation of a mineral or group of minerals under every variety of condition which we may suppose it to have passed through in the earth, provided only we can reproduce that condition in the laboratory.

During the past quarter of a century there has arisen in the middle ground between physics and chemistry a new science of physical chemistry, in the development of which generalisations of great value in the study of minerals have been established. So long ago as 1861 the distinguished German chemist, Bunsen, pointed out that the rocks must be considered to be solutions, and must be studied as such; but inasmuch as comparatively little was known about solutions in those days, and the rocks at best appeared to be very complicated, no active steps in that direction were taken during Bunsen's life. But in recent years solutions have been widely studied, under rather limited conditions of temperature and pressure, to be sure, but it has resulted in establishing relations—like the *phase rule*—of such effective and far-reaching character that now, after half a century afterward, we are entering with great vigour upon the prosecution of Bunsen's suggestion. It is now possible to establish definite limits of solubility of one mineral in another, and definite conditions of equilibrium, even in rather complicated groups of minerals, which enables us not only to interpret the relations developed by such a thermal study as that outlined above, but also to assure ourselves that only a definitely limited number of compounds of two minerals can exist, that they must bear a constant and characteristic relation to each other under given conditions of temperature and pressure, and that changes of temperature and pressure will affect this relation in a definite and determinable way. Physical chemistry not only takes into account the chemical composition of mineral compounds, but their physical properties as well, throughout the entire temperature region in which they have a stable existence, and therefore furnishes us at once with the possibility of a new and adequately comprehensive classification of all the minerals and rocks in the earth. The value of an adequate system of classification appeals chiefly to those whose duties bring them into intimate relations with the subject-matter of a science; but so much may appropriately be said, that a consistent application of physical chemistry to the minerals may operate in the not far distant future to develop an entirely new conception of the science of mineralogy.

As the number and scope of such exact measurements increase, we gradually build up what may be called a geologic thermometer. Just as the location of fossils offers a basis for estimating geologic time, it often happens that a mineral takes on a variety of different crystal habits, according as it happened to form at one temperature or another. Quartz, for example, which is one of the commonest of natural minerals and one of the most familiar, undergoes two changes in its crystal form which leave an ineffaceable record. One occurs at 575° and the other at 800°. An optical examination of even a minute quartz fragment from the mountain side will reveal to the skilful petrologist whether the crystal formed at a temperature below 575°, between 575° and 800°, or above 800°. And if we could have at our disposal a great body of such exact measurements of the temperate region within which particular crystals originate and remain stable, we could apply that directly to terrestrial formations in which this mineral occurs, and read therein the temperature which must have obtained during their formation. All this will not be done in the first year, and perhaps not in the first decade; but the ultimate effectiveness of this method of procedure in establishing the relations between the minerals and the valuable ores is now as certain of success as the operations of any of the sciences which have now come to be characterised as exact, as opposed to descriptive.

There is one important difference between the great laboratory of nature and its feeble human counterpart. Nature operated with large masses, mixed with a generous hand, and there was always plenty of time for the growth of great individual crystals, at which we marvel whenever we encounter them, and which we have sometimes come to regard highly as precious stones. To carry these processes into the laboratory is necessarily fraught with certain limitations. The quantities must remain small, and the time and available financial resources will always be limited. So long as we are able to ascertain the optical character of a crystal with equal exactness, whether the crystal is of the size of the proverbial mustard-seed or a walnut, the scientific laboratory cannot properly afford the time necessary to produce the large crystals which nature offers so abundantly. Furthermore, the crystals of nature often owe their brilliant colouring to slight admixtures of impurity, which to the scientific laboratory spell failure, and are avoided with the utmost care. Most of the mineral crystals, when reproduced in the laboratory, are quite colourless. And so, although the question is often raised whether we are not really engaged in the artificial production of gems, and although the seductive character of such an investigation would no doubt appeal to many, it must be admitted that the geological laboratory is not, and probably will never become, the serious competitor of nature in those directions in which nature has produced her most brilliant effects.

In what has preceded I have laid emphasis upon the value of experimental measurements in the systematic development of a more exact science of the earth. It is a fair question, and one which is very often raised, whether all this investigation has a utilitarian side—whether the knowledge obtained in this way, and with such difficulty, will help to solve any of the problems arising in the exploitation of our mineral resources or assist in our industrial development. It is neither wise nor expedient in entering upon a new field of research to expatiate long upon its practical utility. Its principles must first be established, after which there is no lack of ingenuity in finding profitable application of them.

The development of thermoelectric apparatus for the accurate measurement of high temperatures was begun and has been perfected in the interest of geophysical research, and it has already found such extended application among the technical industries as to demand the manufacture and calibration of thousands of such high-temperature thermometers every year. The tempering and impregnation of steel are no longer dependent upon the more or less trained eye of the workman, but are done at measured temperatures and under known conditions which guarantee the uniformity of the product and admit of

adaptation to particular purposes, like high-speed tools or armour-plate. This has the incidental but far-reaching industrial consequence that workmen of great individual skill in these industries are much less necessary now than formerly. Everything is accomplished by bringing temperature conditions under mechanical control, and making them absolutely reproducible without the exercise of critical judgment on the part of anyone.

A more intimate knowledge of the behaviour of the minerals themselves finds almost immediate industrial application. An industry which has grown to enormous proportions in recent years is the manufacture of Portland cement, about which little more has been known than that if certain natural minerals were taken in the proper proportions and heated in a peculiar furnace developed by experience, the resulting product could be mixed with water to form an artificial stone which has found extensive application in the building trades. Chemical analysis readily established the fact that the chief ingredients in a successful Portland cement were lime, alumina, and silica, with a small admixture, perhaps, of iron and magnesia; but the relation in which these ingredients stood one to another—that is, which of them were necessary and which merely incidental—and in what compounds and what proportions the necessary ingredients required to be present, has never been satisfactorily established. When we know the stable compounds which lime, alumina, and silica can combine to form, together with the conditions of equilibrium between these for different temperatures and percentages of each component, a formula can be written offhand for a successful Portland cement from given ingredients somewhat as an experienced cook might write out the recipe for a successful dish. Such definite and valuable knowledge is not beyond our reach. To obtain it requires, in fact, precisely the same system of procedure as that described above, which has already been successfully applied to many of the natural minerals reproduced and studied in the Geophysical Laboratory during the past five years. It happens that we have examined a considerable number of these very mixtures in our recent work upon the rocks. All the compounds of lime, silica, and alumina have been established, and a portion of the silica-magnesia series and their relations have been definitely determined throughout the entire range of accessible temperatures. There is no reason to apprehend serious difficulty in applying the same procedure to the commercial ingredients of Portland cement, and replacing the present rule-of-thumb methods and uncertain products with dependable cements. The problem of determining the relation of the ingredients in commercial cement and the conditions necessary for its successful formation is exactly the same in character as that of determining the conditions of formation of the rocks of the earth.

A physico-chemical investigation of the sulphide ores over a wide range of temperatures and pressures has also been undertaken, which has developed a large body of exact information of value in the mining industry. And such illustrations could be continued almost indefinitely if it would serve any useful purpose to do so.

The industrial world is not, as a rule, interested in scientific principles; the principle must first be narrowed down to the scope of the industrial requirement before its usefulness is apparent. The immediate effect of an industrial point of view is therefore to restrict investigation at the risk of losing sight of underlying principles entirely. An illustration of this has come down to us through the pages of history of a character to command and receive the utmost respect, for such another can hardly be expected to occur. We have honoured the early philosophers for their splendid search after broad knowledge; but in what is now the field of chemistry, they allowed themselves to be turned aside to the pursuit of a single, strictly utilitarian problem—the transmutation of base metals into gold. The history of chemistry is a history of this one problem from the fourth to the sixteenth century—twelve centuries before a man arose whose broader point of view enabled him to divert the fruitless search into other channels, from which a science has slowly arisen which is now so broad as to overlap most of the other sciences, and withal so practical that scarcely an industry is entirely independent of it.

The so-called practical questions may therefore as well be left to take care of themselves. There has been no lack of ingenuity in making profitable application of systematic knowledge whenever the need for it became insistent, for the rewards of such effort are considerable. And it is no longer an argument against proceeding to establish relationships in a new field that the scope of their application cannot be completely foreseen.

Now, what more promising questions occur to one than these: If the earth was originally fluid, as it appears to have been, and has gradually cooled down to its present state, its component minerals must at some time have been much more thoroughly mixed than now; how did they come to separate in the process of cooling into highly individualised masses and groups as we now find them, and what were the steps in their deposition? If the whole earth was hot, whence came the marble of which we have so much and which can withstand no heat? What has given us the valuable deposits of iron, of gold, of precious stones? What determines the various crystal forms found in the different minerals, and what is their relation? Some must have formed under pressure, some without pressure, some with the help of water, and some without. Where is the centre, and what the source of energy in our volcanoes? All these questions, and many more, the geophysicist may attempt to answer.

THE AGE OF THE EARTH.[1]

THE doctrine of uniformity in geology stated by Hutton in the words "we find no vestige of a beginning and no prospect of an end" was accepted by many until Lord Kelvin surprised this school of geologists in 1868 by drawing a very decided limit to the possible age of the earth.

Lord Kelvin assumed that in the remote past the earth was molten, and that it cooled down as a whole uniformly until the crust just solidified. Then the earth's interior is at a definite temperature (which we can now roughly estimate from the melting point of the rocks of the crust), while the surface has much the same temperature as now. The rate of cooling is determined by the thermal conductivity of the crust, *i.e.* by the rate at which the interior heat can escape.

It becomes possible to calculate what the temperature gradient near the surface will be at any subsequent time, or conversely, if we know the temperature gradient, to calculate what time has elapsed since the crust solidified.

By the age or antiquity of the earth I understand Lord Kelvin means the time that has elapsed since the crust solidified. The "geological age" would be less than this. The antiquity of a rock (or mineral) would only in the case of the oldest rocks be the same as the geological age. Thus the age of a mineral is a minimum estimate of the earth's age.

The temperature gradient at a depth x and time t is

$$d\theta/dx = \theta_0 e^{-x^2/4Kt} / \sqrt{4\pi Kt}$$

where θ_0 is the initial surface temperature, K the conductivity of the material of the earth.

In applying this to the earth, we notice that x is small and t large, so that

$$d\theta/dx = \theta_0 / \sqrt{4\pi Kt}.$$

All these quantities are known except t. Lord Kelvin's estimates of the antiquity of the earth, using this method, varied a good deal, but forty million years was the maximum he would admit latterly.

Sources of heat, the radio-active elements, are now known which Lord Kelvin did not, of course, take into account. The earth can no longer be regarded as a body possessing only its sensible heat to supply the stream continually flowing from the interior to the surface—heat which is, presumably, radiated into space.

Lord Kelvin's treatment of the problem might be modified by taking into account the additional supply of "radioactive" heat. But the discoveries of radio-activity afford, it appears to the writer, an alternative treatment of the history of the earth which is more convincing. This treat-

[1] Portion of the presidential address delivered to Section A, Australasian Association for the Advancement of Science, 1911, by Prof. T. H. Laby.

ment consists in accepting the antiquity of the earth, as found by Prof. Strutt using a radio-active method, and then examining the heat of the earth in the light of that result. Every estimate as to the age of the earth assumes to some degree a uniformity of present phenomena throughout the whole life of the earth; this uniformity is assumed by Sir Archibald Geikie in the rate of deposition of sediments,[2] by Prof. Joly for the addition of sodium to the sea,[3] by Lord Kelvin for the conduction of heat by rocks, and, finally, by Prof. Strutt for the rate of accumulation of helium in minerals or rocks.[4] Now of all these processes the last is the only one which is not altered by temperature, pressure, or other physical conditions.

Prof. Strutt has concluded from a very refined determination of (1) the present rate of production of helium, and (2) the total accumulated helium in thorianite that it has taken 280 million years for the helium to accumulate. As the earth is presumably older than the mineral, this is a minimum age for the earth.

The Heat of the Earth.

The question at once arises how is it that the temperature gradient of the crust is not less than it actually is, for, according to Lord Kelvin, after only forty million years the gradient would have fallen to the present value. During the remaining 240 million years it would have gone on decreasing at a rate proportional to the square root of the time. It becomes evident, then, that there is actually a need for the heat supplied by the radio-activity of the crust if all these deductions are to be reconciled.

The Heat Stream from the Interior.

The heat stream from the interior is that flowing through the earth's surface layers. This is

$$\begin{aligned} H &= 4\pi r^2 K\, d\theta/dr \\ &= 5\cdot1 \times 10^{18} \times 0\cdot004 \times 1/3200 \\ &= 6\cdot4 \times 10^{12} \text{ calories per sec.,} \end{aligned}$$

where r is the earth's radius, $d\theta/dr$ the temperature gradient of the crust at the earth's surface, and K its thermal conductivity. We must attempt to substitute such numerical values for the temperature gradient and the conductivity as will give a correct result for the earth's whole surface. The nature of the data is indicated by the following[5] estimates:—

Land Surface; Average Temperature Gradient

Prestwich ...	1° C. per 2430 cm.	Geikie ...	1° C. per 3100 cm.
Kelvin	,, 2750 ,,	Brit. Assn. ...	,, 3240 ,,
Schardt ..	,, 3200 ,,	C. King ...	,, 3890 ,,

The value used above is 1° per 3200 cm.

Land Surface	Conductivity at ordinary temperature in calorie degree^{-1} cm.$^{-1}$ sec.$^{-1}$
Sedimentary rocks	0·0055 to 0·0021; mean 0·0041
Igneous rocks ...	0·0053 to 0·0017; mean 0·0042

There is more uncertainty in the value of K than in that of $d\theta/dr$. A more accurate estimate of the heat loss of the earth is desirable. Convection currents make the conduction method ordinarily inapplicable to the sea or lakes; but under special conditions, such as fresh water between 0° and 4° C., might not the method be applicable to a lake?

Heat from Radium and Thorium in Rocks.

Lord Kelvin supposed that this heat stream, which we see amounts to 6×10^{12} calories per sec., came from the sensible heat of the earth's interior as it cooled by loss to the surface. That the heat of disintegration of radium might play an important part in cosmical physics was pointed out by Rutherford and Soddy.[6] The accurate determination of radium and thorium in rocks has shown that there is an embarrassingly large supply of heat being continuously emitted by these substances. Determinations of radium in rocks have been made by Strutt and Joly and others, but there is need for a systematic survey.

Radium in Igneous Rocks.

Number of rocks	Mean radium content in gm. per gm. of rock	Observer
28	$1\cdot7\times10^{-12}$	Strutt (Proc. Roy. Soc., May, 1906) corrected by Eve.
4	2·16 ,,	Eve and McIntosh (Phil. Mag., Aug., 1907).
19	0·79 ,,	Fletcher (Phil. Mag., July, 1909, in Joly's laboratory).
13	1·46 ,,	Farr and Florance (Phil. Mag., Nov., 1909).
Mean 64	1·3 ,,	Observers other than Joly.
126	7·01 ,,	Joly ("Radioactivity and Geology," Phil. Mag., Oct., 1909).

There is rather a wide difference between the mean of Joly's large number of determinations and the mean of other observations. There is clearly a discrepancy, which would probably be most quickly elucidated by the chief observers determining the radium in specimens of the same rock. If we give equal weight to the mean of Joly's observations 7×10^{-12}, and to $1\cdot3\times10^{-12}$ the mean of other observers, the final average is $4\cdot1\times10^{-12}$ gm. Now the heat given out by radium[7] in complete radio-active equilibrium (uranium to radium F)[8] is 0·06 calorie per sec. per gm., so that each gm. of the earth's crust, on account of the radium it contains, is the source of $4\cdot1\times10^{-12}\times0\cdot06=2\cdot5\times10^{-13}$ calorie per sec., a source of heat unaffected, so far as experiment has shown, by temperature or pressure.

Thorium in the Earth's Crust.

But the uranium-radium series are not the only source of such heat; thorium is also widely distributed. Fewer rocks have been examined for it than for radium, but the following results have been recorded:—

Thorium in Igneous Rocks.

Number of rocks	Locality	Thorium per gm. of rock	Observer
19	Transandine	$0\cdot56\times10^{-5}$	Fletcher, Phil. Mag., July, 1910
59	St. Gothard and Lavas	1·3 ,,	Joly, Phil. Mag., July, 1909
4	European ...	5·0 ,,	Blanc, Phil. Mag., 1909
Mean for 82		$1\cdot3\times10^{-5}$	

The heat emitted by thorium in radio-active equilibrium is 5×10^{-9} calories per sec. per gm.,[9] and that by the average amount of thorium in rocks $6\cdot5\times10^{-14}$ cal. sec.$^{-1}$ gm.$^{-1}$.

Heat due to Radium and Thorium in Rocks.

Thus the heat emitted by the uranium, radium, and thorium found in surface rocks is $(24\cdot6+6\cdot5)10^{-14}=3\times10^{-13}$ cal. per sec. per gm. Blanc,[10] having found nearly four times as much thorium as our mean value, concluded that thorium contributed as much heat as uranium and radium.

Distribution of Radio-active Elements.

If the whole mass of the earth (6×10^{27} gm.) were the source of as much radio-active heat as the surface rocks, the heat emitted would be $1\cdot8\times10^{15}$ calories per sec., or about 300 times the heat flowing from the interior as deduced from the conductivity and temperature gradient of the surface rocks. But if the interior of the earth gains more heat than it loses, then its temperature is rising; nor is the geological and other evidence that the earth was once

[2] Geikie, Brit. Ass. Rep., 1899.
[3] Joly, Brit. Ass. Rep.
[4] Strutt, Proc. Roy. Soc.
[5] Joly, "Radioactivity and Geology."
[6] Phil. Mag., May, 1903; Proc. Roy. Soc.
[7] Von Schweidler and Hess, "Le Radium," February, 1909.
[8] Boltwood, *Amer. Journ. Sci.*, 1908.
[9] Pegram and Webb, *Phy. Rev.*, 1908.
[10] Science Abs., No. 1057, 1909.

hotter than now the only contradiction to a "heating-up" earth.

Assuming, as before, the antiquity of the earth to be at least 300 million years (t), then in that period a supply of heat of 3×10^{-13} cal. per gm. per sec. (h) would have raised the interior of the earth to a temperature given by

$$S\theta = ht$$
$$\theta = 3\times10^{-13}\times3\times10^{8}\times3\cdot2\times10^{7}/0\cdot02 = 14{,}000^{\circ}\text{ C.},$$

where S is the specific heat of the internal material. Though loss by conduction to the surface and latent heat effects are here neglected, the calculation is sufficient to show that a uniform distribution of the radio-active elements would give rise to internal temperatures too high to be reconciled with the observed temperature gradients.[11] We may safely conclude that there is very much less uranium, radium, and thorium in the inner portion of the earth than there is in the crust, and a maximum limit may be assigned to the content of radio-active elements. It would appear a minimum limit may also be set.

According to Lord Kelvin, as we have seen above, a period of cooling of more than forty million years could not have elapsed between the solidification of the terrestrial crust and the establishment of the present temperature gradient. If, however, the antiquity of the earth is more than 300 million years, then the temperature gradient has been maintained by some other source of heat, and the radio-activity of the rocks is amply sufficient for the purpose if it extends to quite moderate depths. The present temperature gradient would be maintained for an indefinite time if the stream of heat from the interior came from the radio-activity of the rocks.

There would need to be $6\times10^{12}/0\cdot06 = 10^{14}$ gm. of terrestrial radium to supply the heat lost by conduction, for a layer of the earth's crust 14 km. deep, if of density 3, has a mass of $2\cdot1\times10^{25}$, and it would give out $2\cdot1\times10^{25}\times3\times10^{-13} = 6\times10^{12}$ cal./sec., assuming the content in this surface layer of radium and thorium, and therefore the heat emission was that of the surface rocks. There is very probably at least this amount of the radio-active elements; otherwise it is not apparent why the temperature gradient of the crust has its present value, though the antiquity of the earth probably exceeds 300 million years. If the age greatly exceeds that period, then the present temperature gradient can depend but little on the secular cooling of the earth from a molten state.

Prof. Strutt[12] has determined the minimum age of thorianite by evaluating the ratio

$$\frac{\text{The quantity of helium in the mineral at present}}{\text{The rate at which the helium is produced}}.$$

The refinement of the experiment will be appreciated when it is recalled that the rate of production of the helium is only 4×10^{-8} c.c. per gm. of thorianite per year. He found, as already mentioned, 280 million years for the age of one specimen and 250 millions for another.

To deduce a minimum age for a mineral in this manner it must be assumed that—

(1) There was no original store of helium in the mineral when it was formed.

(2) The mineral has not gained helium at any time except as it does now.

(3) That the present rate of accumulation of helium is the same as in the remote past, when possibly high pressures and temperatures obtained.

The observational basis for these assumptions are:—

For (1) and (2). If the helium was originally present in the mineral when it was formed, or added later, then we would expect to find helium in other minerals in which helium is not now accumulating, but no such minerals are known. Helium is only found in appreciable quantities when associated with thorium and uranium. The mechanism[13] of how it is continuously and unchangingly produced from these elements is known in great detail.

For (3). That radio-active changes are independent of temperature and pressure has been repeatedly tested and confirmed.

[11] This will be seen at once to follow from a calculation given by Strutt, Proc. Roy. Soc., p. 482, 1906.
[12] Proc. Roy. Soc., lxxxiv., 379, 1910.
[13] See for example Rutherford, Nobel lecture, 1908.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Marquise Arconati Visconti has made a donation of 500,000 francs to the University of Paris, to be employed for the benefit of the faculties of science and arts.

IN connection with the Institute of Chemistry, Mr. C. F. Cross will deliver the first of two lectures on "Cellulose" at University College, London, on Friday, January 26. Sir William Ramsay, K.C.B., F.R.S., will preside.

THE post-graduate scholarship, of the value of 200*l.* per annum, in naval architecture has been awarded by the Royal Commissioners for the Exhibition of 1851 to Mr. Arthur Cannon, of Glasgow University, and formerly of the Royal Naval College, Greenwich.

WE learn from the issue of *Science* for December 15, 1911, that nearly a hundred students from the college of engineering of the University of Wisconsin were then on their yearly tour of inspection of great engineering plants of the eastern States. Engineering plants in Chicago, Milwaukee, Niagara Falls, Pittsburg, Schenectady, N.Y., and New York City were visited. These tours are required of students of engineering during their junior and senior years, and are arranged to cover industries that illustrate the work of the course pursued by the student. Four professors accompanied the students on their tour of inspection.

THE annual meeting of the Geographical Association will be held on January 13 at University College, Gower Street, London, W.C. In the morning, at 11 a.m., a discussion on the organisation of home-work in school geography will be opened by Prof. L. W. Lyde, and a paper on the population of the world will be read by Prof. A. J. Herbertson. In the afternoon, at 3 p.m., Dr. G. R. Parkin will deliver his presidential address, and afterwards Prof. Herbertson will exhibit lantern views of typical land-forms selected by a committee of the International Geographical Congress, and Miss S. Nicholls maps and views of typical land-forms in the Near East.

IT is announced in *Science* that by the will of Mrs. Jan K. Sacher the University of California is to receive 100,000*l.* The will stipulates that 40,000*l.* is to be spent on a granite campanile tower, 300 feet in height, to be erected in the centre of the University grounds. An endowment of 100,000*l.* has been secured, we learn from the same source, by Huron College, in Huron, S.D. St. Lawrence University, too, has obtained a 40,000*l.* endowment fund, of which the General Education Board has contributed 10,000*l.* Our contemporary also states that by the will of Miss J. M. Smith the sum of 1000*l.* is given to the American Association for the Advancement of Science. Similar bequests are made to the National Geographic Society of Washington and to the American Forestry Association of Washington. Other items of interest to men of science are 2000*l.* to the University of Pittsburg, 2000*l.* to the Allegheny Observatory, and 1000*l.* to the School of Liberal Arts and Sciences.

THE Senate of the University of St. Andrews has decided to confer the honorary LL.D. degree, *in absentia*, upon the following distinguished men, who were chosen for the degree on the occasion of the celebration of the 500th anniversary of the foundation of the University last September, but were unable to be present on that occasion:—Prof. Pietro Blaserna, professor of experimental physics in the University of Rome, president R. Accademia dei Lincei; Prof. M. J. M. Hill, F.R.S., Astor professor of pure mathematics, University College, London, and lately Vice-Chancellor of the University of London; Prof. Hugo Kronecker, professor of physiology, University of Berne; Prof. G. M. Mittag-Leffler, professor of pure mathematics in the University of Stockholm and Rector of that University, founder and editor of *Acta Mathematica*; M. Paul Meyer, directeur de l'Ecole Nationale des Chartes, Paris, professeur honoraire au Collège de France; Prof. Karl Pearson, F.R.S., Galton professor of eugenics and director of the Laboratory of National Eugenics, University of London; Mr. Charles D. Walcott, secretary of the Smithsonian Institution, Washington, U.S.A.; and Prof. P. Zorn, professor of international law in the University of Bonn.

THE annual meeting of the Association of Public School Science Masters will be held on Wednesday and Thursday, January 10 and 11, at the London Day Training College, Southampton Row. The president this year is Sir J. J. Thomson, and the meeting promises to be of unusual interest. The exhibition of scientific apparatus, books, and new experiments will probably be the largest the association has yet brought together, and several subjects in the programme should promote lively discussion. During Wednesday afternoon Messrs. M. D. Hill and E. J. Lewis will read short papers on "Chemistry and Physics as a necessary Introduction to Biology" and "Plant Biology" respectively. Dr. Ludlam will also discuss the educational value of "Qualitative analysis." Sir J. J. Thomson will deliver his address on Thursday at eleven, and will be followed by Mr. C. E. Ashford, on "The Place of Electrostatics in a Science Course." On Thursday afternoon there will be a discussion, commenced by Mr. G. F. Daniell, on "Practical Examinations in Science." Mr. A. Vassall will also read a short paper on "Educational Psychology." On Wednesday evening there will be a dinner at the Trocadero in conjunction with the Mathematical Association. The secretary asks us to state that the discussions and exhibition are open to anyone interested in science teaching.

THE following courses of advanced lectures, which are free to students, in scientific subjects have been announced for delivery in connection with the University of London during the first term of 1912. Eight lectures on "The Self-government of the Pueblo Indians under Spanish and American Administration" will be given by Miss Barbara Freire-Marreco at the London School of Economics and Political Science on Thursdays at 3 p.m., beginning on January 25. Five lectures and one demonstration on "Genetics" will be given by Prof. F. Keeble at the Imperial College (Royal College of Science) on Thursdays at 5 p.m., beginning on January 18. Dr. W. N. Shaw, F.R.S., will lecture on "The Meteorology of the Globe" at the Meteorological Office, South Kensington, on Fridays at 5 p.m., beginning on January 19. Four lectures on "Recent Work in Physiology relating to the Circulation and to the Nervous System, with Special Reference to the Human Subject," will be given by Dr. A. D. Waller, F.R.S., in the Physiological Laboratory, South Kensington, beginning on Tuesday, January 23, at 5 p.m. Fourteen lectures on "The Hæmoflagellates" will be given at the Lister Institute of Preventive Medicine, Chelsea, by Prof. E. A. Minchin, F.R.S., on Tuesdays and Fridays at 5 p.m., commencing on Tuesday, January 16. Four Chadwick lectures on "Water and Water Supply" will be given by Sir Alexander R. Binnie at the Institution of Civil Engineers on Thursdays, beginning on February 1, at 5.30 p.m. Five lectures entitled "A Study of Jöhne's Bacillus of Cattle and the Lepra Bacilli of Man and Rats" will be given, under the will of the late Mr. Thomas Brown, by Mr. F. W. Twort, superintendent of the Brown Animal Sanatory Institution, in the Theatre of the Royal College of Surgeons, Lincoln's Inn Fields, W.C., on Monday, January 8, and the four following days, at 4 p.m.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, December 19, 1911.—Mr. R. Lloyd Praeger in the chair.—Prof. James **Wilson**: The inheritance of the dun coat-colour in horses. In a previous paper —the inheritance of coat-colour in horses—published in 1910 (Sc. Proc. Roy. Dublin Soc.), it was shown that the ordinary colours fit into each other like a nest of Chinese boxes, chestnut being innermost, and then, coming in succession, black, bay, brown, dun, and grey and roan. The data concerning dun were few, and its position was merely suggested in a footnote. More data—500 to 600 cases—have since been collated, and these confirm the former placing. From this it follows that dun cannot be a "reversion," since it can result only from dun matings and occasionally from grey and roan. The author discussed the history of the idea that dun is a reversion. It probably originated in Lord Morton's quagga-crossing "experiments," and in Dr. Macdonald's criticism of these (both published by the Royal Society). Hamilton Smith's theory that horses are descended from five original stripes did not require a reversion theory; but Darwin's theory, expressed tentatively, that horses are descended from a single dun-coloured and striped species, required one, and to him mainly are we indebted for the opinion that dun is a reversion. Darwin relied upon Lord Morton's description of the foals his chestnut mare bore after her quagga hybrid, and on three other cases. Lord Morton said that one of the chestnut mare's foals had a faint dun tint in two places, and Darwin called two of them "partially dun"—later writers have called them dun altogether. These foals, however, were ordinary bays, and the other three cases were undoubted misdescriptions. Data are collected in the present paper from various stud-books, and these are confirmed by the progeny of two homozygous dun sires which were stationed recently on Clare Island, on the coast of Mayo.—E. A. Newell **Arber**: Contributions to our knowledge of the floras of the Irish Carboniferous rocks. Part i.—The Lower Carboniferous (Carboniferous Limestone) flora of the Ballycastle Coalfield, Antrim. Of the seven species recorded from this coalfield, *Adiantites antiquus* (Ett.), *Sphenopteris flabellata*, Baily, *Lepidodendron Veltheimi*, Sternb., and *L. Volkmannianum*, Sternb., are the more important. The evidence of the flora points to the conclusion that the coalfield is of Lower Carboniferous age, and that the rocks belong to the higher, or Carboniferous Limestone, horizon of the Lower Carboniferous.

CALCUTTA.

Asiatic Society of Bengal, December 6, 1911.—G. R. **Kaye**: A brief bibliography of Hindu mathematics. This is a list of works dealing with the history of Hindu mathematics. It is professedly incomplete, and it is difficult to decide what ought and what ought not to be included. This list requires amplification, particularly in the matter of Sanskrit texts and manuscripts. The original Hindu works do not go beyond the time of Bhâskarâ (twelfth century A.D.), as, after this period, Hindu mathematical works cease to have any historical interest.—Rev. H. **Hosten**: Father A. Monserrate's "Mongolicæ Legationis Commentarius." This precious manuscript, after passing successively through Fort William College, the Calcutta Public Library, and the Imperial Library, was transferred in 1903 to St. Paul's Cathedral Library, where the Rev. W. K. Firminger discovered it. It must have belonged formerly to one of the Jesuit houses of Goa. How it came to Calcutta it is impossible to say. The earliest account of northern India by a European since the days of Vasco de Gama, the manuscript contains a detailed history of the first Jesuit mission to Akbar, and more than 100 pages are consecrated to Akbar's campaign against Kâbul in 1581–2. There is in it an excellent map, drawn to scale, showing all the places passed through by Monserrate between Goa, Sūrat, Agrā, Lahor, and Kābul (1580–2). It appears from the preface that Monserrate was the author of four distinct works:—(1) "Mongolicæ Legationis Commentarius"; (2) a work on the geography and natural history of India; (3) a history of his journey to Ethiopia; (4) a work on the geography and natural history of Arabia.—Prafulla Chandra **Ray** and Rasik Lal **Datta**: Contributions from the Chemical Laboratory, Presidency College. Allylammonium nitrite. A short paper dealing with the preparation and properties of allylammonium nitrite. The substance was made by double decomposition of allylamine hydrochloride and silver nitrite. Allylamine nitrite is a thick brownish liquid with the characteristic smell of all alkylamine nitrites.—Jitendra Nath **Rakshit**: Contributions from the Chemical Laboratory, Presidency College. Preliminary note on sodiumdiacetamide. This note deals very shortly with the method of preparing

$$\begin{matrix} CH_3.Co \\ CH_3.Co \end{matrix} > N.Na.$$

Acetamide (purified by recrystallisation from benzene), anhydrous thiophene, free benzene, and freshly cut metallic sodium were boiled together under a reflex condenser for twenty or thirty minutes, when a copious crop of white crystals separated.—B. L. **Chaudhuri**: Fresh-water

sting-rays of the Ganges. Two species of Trygonidæ live and breed in the River Ganges above tidal influence, namely, *Hypologhus sephen* (Forscål) and *Trygon fluviatiles* (Ham. Buch). Their Indian name is discussed, and particulars as regards their capture are given.

BOOKS RECEIVED.

Die Biologie des Donaudeltas und des Inundationsgebietes der unteren Donau. By Dr. Gr. Antipa. Pp. iv + 48. (Jena: G. Fischer.) 1.50 marks.

Handbuch der Phototelegraphie und Telautographie. By Profs. A. Korn and B. Glatzel. Pp. xvi + 488. (Leipzig: O. Nemnich.) 28 marks.

Neue Grundlagen der Meteorologie. By P. Hoitsy. Pp. 107. (Budapest: Franklin-Verein.) 2 marks.

Unsere Kenntnisse von den Seriengesetzen der Linienspektra. By Dr. B. Dunz. Pp. iii + 186. (Leipzig: S. Hirzel.) 2 marks.

Zur Phylogenie der Primulaceenblüte. By Dr. S. Thenen. Pp. iv + 131. (Jena: G. Fischer.) 8 marks.

Physiologie des Menschen. By Prof. L. Luciani. Translated by Profs. S. Baglioni and H. Winterstein. Fünfzehnte (Schluss) Lieferung. Pp. 641–782 + viii. (Jena: G. Fischer.) 4 marks.

Monumentales und Dekoratives Pastell. By Prof. W. Ostwald. Pp. vi + 105. (Leipzig: Akademische Verlagsgesellschaft M.B.H.) 2.40 marks.

Denkschrift über die Gründung eines Internationalen Instituts für Chemie. By Prof. W. Ostwald. Pp. 30. (Leipzig: Akademische Verlagsgesellschaft M.B.H.) 1.50 marks.

Das Pflanzenreich. Edited by Prof. A. Engler. 51 Heft: Sphagnales—Sphagnaceæ (Sphagnologia universalis). By C. Warnstorf. Pp. iv + 546. (Leipzig: W. Engelmann.) 27.50 marks

DIARY OF SOCIETIES.

FRIDAY, JANUARY 5.

GEOLOGISTS' ASSOCIATION, at 8.—On the High Terrace Gravel and on a Palæolithic Implement Factory, Dartford Heath: R. H. Chandler and A. L. Leach.—On the London Clay and Bagshot Beds (Passage Beds), and on the Gravel of Shooter's Hill, Kent: A. L. Leach.

MONDAY, JANUARY 8.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Production of Formic and Acetic Acids by the Atmospheric Oxidation of Turpentine: C. T. Kingzett and R. C. Woodcock.—A Rapid Volumetric Method for the Determination of Free Sulphur: C. Davis and J. L. Foucar.—The Relative Absorption of Dyes by Sand and Natural Fibres: W. P. Dreaper and W. A. Davis.—Ingrain Dyeing—Influence of Certain Groups on the Re-solution Factor: W. P. Dreaper.

VICTORIA INSTITUTE, at 4.30.—The Greek Papyri: Prof. G. Milligan.

TUESDAY, JANUARY 9.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Reinforced Concrete Wharves and Warehouses at Lower Poorung, Shanghai: S. H. Ellis.—The Direct Experimental Determination of the Stresses in the Steel and in the Concrete of Reinforced Concrete Columns: W. C. Popplewell.—Composite Columns of Concrete and Steel: W. H. Burr.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Some Problems in Garment Dyeing: F. G. Newbury.—Aluminium in the Service of Chemical Industry: Dr. Richard Seligman.

WEDNESDAY, JANUARY 10.

GEOLOGICAL SOCIETY, at 8.—On a Late Glacial Stage in the Valley of the River Lea subsequent to the epoch of River-drift Man: S. Hazzledine Warren.

THURSDAY, JANUARY 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Propagation of Waves through a Stratified Medium, with Special Reference to the Question of Reflection: Lord Rayleigh, O.M., F.R.S.—On the Variation of the Specific Heat of Water, with Experiments by a New Method: Prof. H. L. Callendar, F.R.S.—The Mechanism of the Semipermeable Membrane and a New Method of Determining Osmotic Pressure: Prof. F. T. Trouton, F.R.S.—Mobility of the Positive and Negative Ions in Gases at High Pressures: A. L. Kovarik.—A New Method of Determining the Radiation Constant: G. A. Shakespear.—The Mechanics of the Water Molecule: Dr. R. A. Houston.

MATHEMATICAL SOCIETY, at 5.30.—Successions of Integrals and Fourier Series: W. H. Young.—A New Condition for the Truth of the Converse of Abel's Theorem: G. H. Hardy and J. E. Littlewood.—On Mersenne's Numbers: A. Cunningham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Some General Principles Involved in the Electric Driving of Rolling Mills: C. A. Ablett.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Note on the Genus Panope Ménard: W. H. Dall.—Nomenclature of the Veneridæ—A Reply to Dr. W. H. Dall: A. J. Jukes-Browne, F.R.S.—The Occurrence of *Helicella heripensis* in Great Britain; Notes on Some British Non-marine Mollusca: A. W. Stelfox.—Characters of Two Undescribed Land Shells from Colombia; Explanation of the Figures Occurring in Westerlund's "Sibirien's Land och Sötvatten Mollusker," 1876; On Two Pre-occupied Specific Names in Gasteropoda: G. K. Gude.

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Elliott & Fry, photographers

William Ramsay.

THURSDAY, JANUARY 11, 1912.

SCIENTIFIC WORTHIES.

XXXVII.—Sir William Ramsay, K.C.B., F.R.S.

If we endeavour to build up to its highest pinnacle Auguste Comte's pyramid of sciences, in which natural science follows upon mathematics, and is succeeded by physiology, and finally by sociology, we reach as the highest of imaginable sciences the science of Geniology, the science of genius, of the excelling man. That such a science is possible has been known for half a century. The investigations of Sir Francis Galton in England, of de Candolle in Geneva, and of some recent workers in Germany, have proved to demonstration that even this rare and shining phenomenon is subject to definite natural laws, discoverable by a careful scrutiny of available facts, laws the significance of which is very great, since the position of any nation among the nations of the world is determined by the qualities and the efficiency of its men of genius.

On surveying the life of Sir William Ramsay in the light of this the youngest of the sciences, one is struck by the extraordinary consistency to be found in it, a consistency by virtue of which the rapid succession of astonishing discoveries filling the latter portion of his life appears as the necessary consequence of a natural and regular process, and almost resembles the working of a machine. Here we find nothing of the irregular curves with distinct maxima occurring in other types of genius, and usually in the most marked degree in youth, as in the case of Sir Humphry Davy, Sir William Ramsay's fellow-countryman, who resembles him in many respects. Ramsay recalls Davy by the brilliancy and the striking originality of his discoveries, which had no relation with any school or predecessor. In Davy's case these discoveries appear more as disconnected peaks suddenly arising from an average level. In Ramsay's case, on the other hand, we can observe how one discovery follows another, how comparatively modest and unobtrusive investigations, which have been accepted in their due place in the great register of the sciences, appear as the necessary foundations for truths of such novelty that their possibility was not even conceived before they were scientifically communicated.

This natural-law consistency is seen in the first instance in William Ramsay's descent. He has himself explained that his male ancestors for seven generations were dyers, thus handing down to him as a long inheritance a familiarity with chemical processes and a facility in chemical ways of thinking. On the mother's side, again, a series of physicians have provided the inherited capacity of the great scientific discoverer. But of all these men, none even remotely resembles Sir William in his eminence among his contemporaries, and, in this case, as in all similar cases, the question arises, how it is possible that such a genius arises from people of good average capacity.

It has, indeed, been established by Galton that an efficiency exceeding the average, but not amounting to genius, is in some families inherited through a whole series of generations. But here we have to deal with one of those extraordinary cases where an average efficiency was well evidenced through a number of generations, but suddenly made way for an incomparably higher personality, in which indeed the characteristic qualities of previous generations can be recognised, but which far surpasses its progenitors in efficiency.

If we bear in mind the well-known laws of heredity discovered by Mendel and de Vries, we know that every descendant is a mosaic of those qualities which have been transmitted to him partly by the father and partly by the mother. In the face of this fact the problem arises how such an unusual personality can be descended from parents of average ability, since it is just from these laws of heredity that we should conclude that another average equipment would result.

The answer which I tentatively should venture as regards this problem is this: The portions of the inheritance constituting a new being probably only on rare occasions fit together or harmonise with each other. The adolescent man then applies the greatest portion of his energy in the task of organising these accidental inheritances for the purpose of common work and harmonious cooperation, and this task uses up the greater part of the available energy, and withdraws it from productive work. It is only in rare cases that the inheritances are so constituted that they fit each other from the beginning, so that the young man has not to expend any energy on the mutual harmonising of his elements, but can immediately set about his creative work. Such a case seems to be that of Sir William Ramsay. On one occasion he described himself as a precocious, dreamy youth, of somewhat unconventional education. The precociousness is a practically universal phenomenon of incipient genius, and the dreamy quality indicates that original production of thought which lies at the basis of all creative activity.

His father, being a man of practical pursuits, who, however, in his free time zealously cultivated scientific works, such as quaternions and geology, introduced young William to the great passion of his life, chemistry, and, as is often the case, an accident was the immediate cause of the new departure. Young William had broken a leg at football, and to ease the tedium of convalescence, his father had given him Graham's "Chemistry" to study, and also brought him small quantities of many chemicals with which he could carry out the experiments described in the text-book. Sir William himself says that it was chiefly the question how fireworks could be prepared which induced him to study Graham's "Chemistry." But very soon the general scientific interest gained the upper hand, and this can very characteristically be gathered from the fact that he persuaded his people to

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take a practical part in the pursuits which interested him. In his fourteenth year William matriculated at Glasgow University, and there commenced his studies. The greatest influence was exerted upon him by William Thomson, whose curious and impressive method of teaching has been graphically and amusingly described by his great pupil. He gave him as a first problem a large heap of old copper wire in the laboratory, and instructed him to take out the kinks from it, and from the way in which the young student accomplished the task Thomson seems to have derived a favourable judgment as to his capacity for solving larger problems. For he soon made him acquainted with the quadrant electrometer, an instrument which at that time only existed in Glasgow, and instructed him to determine the potential difference between all kinds of objects found in the laboratory, or imported into it, such as a children's toy balloon. We can imagine that if such an originally constituted spirit could be at all affected by teaching, he must have been profoundly affected by this teacher. For William Thomson belonged to the same type of "romantic" or rapidly producing investigators as did Ramsay himself, and hence he made a particularly strong and permanent impression on that plastic developing genius.

The regular study of chemistry which followed upon this irregular course was made under Tatlock in Glasgow, and in this case also Ramsay appears to have distinguished himself so decidedly that his teacher after a short time made him an occasional deputy in the class.

At eighteen years of age the young student in Glasgow had learned whatever was to be learned there, and he had now to pursue his further study of chemistry. For this only Germany was at that time to be considered. But the Franco-German War had just broken out, and it therefore appeared somewhat risky to follow the original idea of continuing his studies in Heidelberg under Bunsen. However, the scene of war moved away so rapidly from the Franco-German frontier, that the German project could be undertaken. Ramsay passed one term with Bunsen, without, however, seeming to carry away a very strong impression, for in the following term he moved on to Tübingen, where he met a number of equally disposed fellow-workers in Fittig's laboratory, and under the guidance of this extremely conscientious teacher and able experimenter he was introduced to the usual problems and methods of organic chemistry. There Ramsay made one of the usual dissertations (on toluyl acids), which does not enable us to recognise the kind of man we have to deal with. After his return Ramsay was for some years assistant in the Glasgow course of study, and there he acquired a very extensive and profound knowledge of the whole field, especially of inorganic chemistry, at the same time laying the foundations of that mastery which he subsequently displayed as teacher in a great laboratory. Nor shall we err in supposing that the method of working a laboratory, as developed under the inspiring guidance of Liebig in Germany, and spread over the laboratories of the whole world as common property of chemical science, has exerted a very profound influence on Ramsay's talents and ideals as a teacher. In any case, we can state that he has approached the great example of Liebig as closely as any distinguished teacher of chemistry since that great time. Particularly in England his extraordinary facility of organising work in a great laboratory, with a diversity of the most varied talents, must be regarded as very rare, considering that they spread over many different regions of science, and thus make results possible which turn out afterwards to be of fundamental importance.

It is very interesting to observe from Ramsay's own communications how he gradually found his way out of organic chemistry, at that time the object of chief interest, into that other region which has since found an independent place as physical, or rather general chemistry. It was first certain practical problems, such as the determination of vapour densities, which introduced him to the more physical problems of chemistry. Here we find the first marks of the growing genius, in the extraordinary independence in the choice of means of solving the problem. Thus he used the pitches of pipes of fixed dimensions for the determination of vapour densities, and thus utilised his own musical talents.

This process was successful (although it has never been published), but he was less fortunate in his attempts to measure the electric conductivity of solutions by means of the telephone. Here we are involuntarily brought to a pause and have to ask ourselves how the geographical distribution of discoveries in electrochemistry, such as have reformed chemistry in the last twenty years, would have arranged itself if the young investigator had at that time been more fortunate in the execution of his experimental ideas.

We also know of physiological investigations concerning anæsthetics, dating from this period, executed in company with some medical colleagues. In these he himself was the experimental subject, as he suffered less under them than his companions. But here also no considerable results were obtained.

The first independent position was obtained by William Ramsay in the year 1880, when the professorship at the University College, Bristol, was entrusted to him. The choice fell upon him in preference to a competitor because, as he himself narrates, he understood Dutch. For he had to make visits to the various members of the council of the College, and was fortunate enough to be of assistance to one of them, an old minister, in the translation of a Dutch text, so that this member gave him his vote, and the choice was made with a majority of one. But soon it turned out to be an exceptionally happy one. A year after that Ramsay was chosen as the principal of the College. In this short time he had not only proved himself to be an excellent teacher, but also an excellent organiser.

The problem of vapour densities, which had first

introduced him to physical chemistry, gave rise to further investigation, in the course of which the habit of expressing experimental results by mathematical formulæ, learned from Sir William Thomson, turned out to be extraordinarily valuable. In this connection originated the fundamental works on evaporation and dissociation, carried out in great part with his assistant, Sydney Young, which first drew the attention of the larger circles of the scientific world upon him. Here also it is suggestive to note how one followed on the other. His intervention in a controversy which was at that time raging in the columns of NATURE concerning "hot ice" suggested to him the possibility of determining the relation between vapour pressure and temperature by introducing into a space under the pressure in question a thermometer the bulb of which was covered with the body under investigation, in this case ice. The resulting temperature corresponding to the pressure turned out to be so precise that the process was soon developed as a general method of determining vapour pressure.

These investigations, which have been published in a number of large essays in the Philosophical Transactions, gave the impetus which led to the appointment of the still youthful professor to the highly esteemed chair at the University College, London, which Sir William Ramsay still adorns. It is true that at that time the great value of these works was imperfectly recognised, and I remember having an opportunity of pointing out to the authorities of the University College with great emphasis that we had here to do with investigations carrying us considerably further than the determinations of the great physicist Regnault, who was then regarded as the first authority on the whole subject.

At this point began the rapid succession of works which brought Ramsay to the scientific eminence which he still occupies. The measurements of surface tensions up to the critical temperature led to the well-known law which allows us to determine molecular weights in liquids. An occasional lecture experiment, during which magnesium nitride was produced, suggested to him to cooperate with Lord Rayleigh in the solution of the problem proposed by the latter concerning the difference in density between nitrogen derived from the air and artificial nitrogen.

By heating nitrogen from the air repeatedly with metallic magnesium, he succeeded in producing a gas that became ever denser, and turned out to be decidedly different from nitrogen itself. At the same time, Lord Rayleigh solved the problem of separating nitrogen from a possible other gas by the repetition of an experiment devised by Cavendish a hundred years earlier. Both these excellent investigators combined for joint continuation of this work, which led to the discovery of argon, the first type of a new class of elements.

But when an element of a new type had been found, the periodic law immediately suggested the existence of a number of other elements of the same type. Thus Ramsay succeeded in a short time in discovering the element helium, belonging to the same group, in certain rare minerals. An incidental occupation with a litre of liquid air, then first made in London by Hampson, led shortly afterwards to the discovery of three further elements of the same type—neon, krypton, and xenon—which were separated from each other and described, using in many cases quite novel methods of determining their properties. Thus while other discoverers were satisfied with single new elements, Ramsay discovered a whole class of elementary substances.

Then when in 1896 Becquerel demonstrated during his stay in Paris his newly discovered dark rays of uranium from which later the discovery of radium resulted, Ramsay showed the keenest interest, and undertook in his own laboratory an investigation of these phenomena.

This work led up to the greatest discovery made by our great investigator, the discovery of the real transmutation of one element into another. The gaseous emanation of radium, which at first had behaved as an entirely new body, showed after some time the lines of helium, and, finally, it was definitely proved that radium in its spontaneous decomposition produced helium in a perfectly regular way. If Ramsay had not come to know helium beforehand as his own child, so to speak, and if he had not, in the course of his work on rare gases, acquired the skill of working with almost immeasurably small quantities of such substances, he would probably not have succeeded in this capital discovery, which placed him among the very first chemical discoverers.

Following upon this work, Sir William Ramsay originated a series of other investigations, some of which are not yet finished, and cannot therefore be dealt with in this place, more especially as he is still at an age at which we may expect great and manifold achievements from him which preclude a final judgment upon his work.

But it may be possible to describe the general type to which Sir William Ramsay belongs as a discoverer. It has already been said that he undoubtedly belongs to the "romantic" type, working with an unusual speed of reaction, and marked by rapid and various productions. The marked peculiarity of this type of investigators, which enables them to train a great number of budding talents and to spur them to extraordinary efforts, has been brilliantly brought out. We may regard the physico-chemical school of Sir William Ramsay as the most important chemical school of his country for a large number of years. He has not been spared the fate of the "romantic" school, inasmuch as he has on occasion made an error in his discoveries. When the unheard-of number of new elements derived from the air rattled down upon the astonished world of chemists, one of these elements, which had been given the name metargon, on account of its similarity with argon, turned out to be carbon monoxide, which had entered the gases by an impurity in the phosphorus. This error did not do much damage, especially since, as Sir William Ramsay remarks himself, there is always in such a case a large

number of good friends who hasten to point out and correct such inaccuracy.

Here we have a life in which merit and good fortune have combined as they rarely do. No external difficulties have stood in the way of the straight-line development of the growing spirit, and the acknowledgments of his contemporaries have crowned his great merits soon enough to give his life the benefit of such stimulus. Thus he has come to be one of the great *international* investigators, known wherever science is cultivated. If we add that Sir William personally belongs to those unassuming and agreeable figures such as can only be found in the small circle of the front-rank men of science, and that his domestic fate, though not free from occasional cares, has given him a more than average degree of contentment, we have stated the conditions which lead us to expect that his sixtieth year of life, which he will shortly complete, will not by any means mark the close of an unusually rich and fruitful life's work.

WILHELM OSTWALD.

ARCHÆOLOGY IN THE "ENCYCLOPÆDIA BRITANNICA."

Collection of Articles (loose sheets) dealing with Ancient History and Archaeology, from the New (11th) Edition of the Encyclopaedia Britannica. (Cambridge University Press, n.d.)

IN no department of knowledge has greater progress been made during the last twenty years than in the realms of archæology and ancient history. A glance at almost any volume of the new edition of the "Encyclopædia Britannica" will bring this fact forcibly home to anyone. By means of the supplementary volumes, which were issued as an appendix to the tenth edition, it was attempted to summarise the course of such progress, and the result was certainly a series of interesting monographs by specialists, whose efforts were, however, largely controlled and cramped by the existence of articles on the same subjects in the earlier volumes, which were admittedly out of date. No such disadvantage characterises the eleventh edition. In fact, this new edition establishes a record of its own by the simultaneous issue of the whole of its twenty-eight volumes. Thus the purchaser has not to wait for years for the work to be completed. On the contrary, he obtains at once a marvellous summary of knowledge, every part of which has been subjected to a final revision by its author at the time of going to press. The amount of labour and organisation which must have been required to bring such a plan to a successful issue is little short of marvellous, and the editor has certainly reason to congratulate himself on the achievement.

His task must have been particularly arduous in keeping the archæological articles abreast of the most recent research. Yet in this section of the work, wherever we have tested it, he has not failed. Take, for instance, such an article as that on Ægean civilisation in the first volume. Here we have an admirable summary by Mr. D. G. Hogarth of the gradual discovery of the remains and their distribution, and a discussion of the general features of Ægean civilisation based upon them; yet even in such a moot section as that on the chronology, we find he has been enabled to make use of data quite recently acquired. The same remark applies to the series of careful monographs on ancient Egypt which have been contributed by several specialists, and to that on Babylonia and Assyria, the greater part of which is from the pen of Prof. Sayce. We have mentioned these three articles in particular as dealing with departments of archæology in which additions to our material and information are being constantly made. Yet, though they all occur within the earlier volumes, they represent the present state of our knowledge equally with those in the final volumes of the work.

With such a wealth of material to choose from, it is difficult to do more than indicate some of the more important and striking features of the present edition. In the arrangement of the material we have noted what appears to us an admirable innovation, the greater weight and prominence given to the general article. On one hand this enables a writer to lend additional interest to his subject by treating it from a more personal and less encyclopædic point of view. Such an article is Mr. C. H. Read's, on archæology, in which he has space, not only to summarise the headings of his subject, but also to discuss its value as a branch of science and the progress that has been made in its organised study. Thus, when dealing with the primitive epochs in the history of man, we note Mr. Read's timely warning to students of prehistoric archæology to use caution in their treatment of that much-debated problem as to whether traces of man have actually been found in deposits of the Tertiary period. As Mr. Read points out, there is no valid reason against the existence of Tertiary man, but the evidence in favour of the belief is not very convincing. For, on one hand, there is considerable doubt as to whether the deposits containing the remains are without doubt of Tertiary times; and, on the other, it is not certain whether the objects found show undoubted signs of human workmanship. On the latter point, a recurrent difficulty, and one which can never be entirely removed, is our ignorance of the precise methods of nature's working. It is certain that natural forces, such as glacial action, earthquake, landslips, and the like, must crush and chip flints and break up animal remains, grinding them and scratching them in masses of gravel or sand. It is almost impossible to separate the markings or crushing of flint and bone due to such natural agencies from others which may have been purposely made by man to serve some useful end. Even the one feature which is commonly held to determine human agency, the "bulb of percussion" (the lump or bulb on the face of a flint weapon at the end where the blow was delivered to detach it from the mass), is not conclusive evidence; for recent investigations have shown that natural forces frequently produce a similar result. Mr. Read's advice in deciding knotty points of this character may be summarised: use caution, and, where possible, obtain collateral evidence of some kind.

Another much-debated question, which is also discussed in the general article on archæology, concerns the apparent break of continuity in man's history which occurs in Europe at the end of the old Stone age, or Palæolithic period. Attempts have indeed been made to bridge this gap by means of a "Mesolithic" period; but the missing links do not occur, at any rate so far north as Britain. Here the last glimpse we get of Palæolithic man shows him living in a cold climate, hunting his prey and scratching his rude drawings on bone and rock, but with only a dawning knowledge of pottery; he sometimes shelters in caves, but generally camps in the open. His successor of the later Stone age is a very different person, living in a Britain which is practically the same as we see it to-day. The severe arctic conditions, with their appropriate fauna, consisting of mammoth, reindeer, &c., have entirely disappeared, and man himself has been changed by the introduction of new arts. Now Neolithic man probably immigrated into northern and central Europe long after Palæolithic man and his characteristic fauna had disappeared. Where then did the earlier race go, and has it any modern representatives? It would be tempting to accept Mr. Boyd Dawkins's theory that Palæolithic man followed the reindeer in its journey northward after the retreating glaciers, and that his modern representative is the Eskimo. But, as Mr. Read points out, the similarities in their culture may well be due to similar conditions of life, and are not convincing evidence of direct descent. Moreover, the skulls of the Eskimo do not resemble any of those of Palæolithic man hitherto found in the caves. In fact, we cannot yet answer this question, though if, as appears possible from recent discoveries in the south of France and in the Pyrenees, the reindeer was there in existence, along with man, at a later period than that of the caves, it is possible that Palæolithic man retreated southwards, and may have left no modern representative of a racial character sufficiently marked for recognition.

These two problems we have referred to, which are among those discussed under the heading of archæology, will serve to illustrate the use made of the general article in this new edition of the "Encyclopædia," in order to collect and discuss under one heading the more important aspects of a subject. Separate articles are, of course, still devoted to special points of interest, such as that on Hallstatt, to mention only one in this connection. In it Prof. Ridgeway gives a valuable account of the celebrated Celtic burial ground near Hallstatt, in Upper Austria, where it has been assumed that the use of iron was first developed, and afterwards spread thence southwards into Italy, Greece, the Ægean, Egypt, and Asia, and northwards and westwards in Europe. It is true that, while elsewhere in Europe and the Ægean the change from bronze weapons to iron is apparently sudden, at Hallstatt iron is seen gradually superseding bronze, first for ornament, then replacing fully the old bronze types of weapon, and finally taking new forms of its own. We may here note that, with regard to the earlier transition from stone to copper; a similarly gradual development has been noted by Prof. Reisner in Egypt at Naga-ed-Dêr and other prehistoric Egyptian cemeteries. On the strength of these results Prof. Elliot Smith a few months ago advanced the theory that Egypt was the original home of metal, and that its use spread thence eastwards into Asia and northwards into Europe and the Ægean area. But there is no need to regard the "Encyclopædia," which naturally can take no account of theories produced after its publication, as already out of date upon this point. For, while Prof. Reisner appears to have made out his case for the independent development of copper in Egypt, it appears to the present writer that there is no need to assume that no other race hit upon the same idea. In fact, it may be that M. de Morgan and his colleagues will some day find in Persia a proto-Elamite equivalent of Naga-ed-Dêr; and should this prove to be within easy reach of the tin supplies of Central Asia, it might also throw light upon disputed questions with regard to the transition from copper to bronze.

We have laid some stress upon the two last-named articles, as they are among the very few that have been sent us which have any bearing, direct or indirect, upon British archæology. We should have liked to refer to articles on Dolmens, Stone-circles, and their possible connection with astronomical ceremonies, and other subjects particularly connected with early British archæology, but the selection of articles sent us deals mostly with classical and Oriental subjects; and these will serve very well to illustrate other aspects of the work. We have already noted some characteristics of the general article in the new edition; another advantage, to which we may also direct attention, is that, where a wide survey is to be taken of material extending over various periods, it makes a far more detailed treatment possible. This is especially the case in the general articles of composite authorship. The treatment of ceramics is an instance in point. Here we are first presented with a general study of the art of pottery, which, both in its treatment and illustration, is such as we should look for in an encyclopædia. It is lucid and informing, and serves as an admirable introduction to anyone desirous of beginning a study of the subject. Such is all that could reasonably be expected of any encyclopædia. But the "Encyclopædia Britannica" now gives us more. The reader, when he comes to the bibliography at the end of this introductory section, is now no longer obliged to go to some library for further information. The "Encyclopædia" itself supplies it; for the introductory section is amplified by a series of articles by specialists on the pottery of ancient Egypt and Western Asia, Greek, Etruscan, and Roman wares, and further sections on Persian, Syrian, Egyptian, and Turkish pottery. This article on ceramics is certainly one of the fullest archæological articles in the work, but it is quite typical of the rest. We clearly have here a deliberate policy on the part of the editor and his assistants to furnish the reader not only with the dry bones of a skeleton, but with plenty of material to fill them out at will.

Another feature that has struck us during a careful study of the articles dealing with ancient history

and archæology is the system of cross-references which has been adopted throughout. One obvious gain has naturally been to avoid repetition and inconsistency; but a further advantage consists in the fact that the reader is enabled to follow up various subsidiary lines of study in cognate articles treating the subject in greater detail or from a different aspect. We have already referred to the article on Ægean civilisation; the reader, if he so desires, may find further information in other important articles on Crete, Mycenæ, and the Troad; while the products of Ægean art are treated under the more technical articles. By such a system of cross-reference the value of the "Encyclopædia," not only as a work of reference, but also as a subject for detailed study, is vastly increased.

There is one point on which we have not touched, but which perhaps distinguishes more than any other this edition of the "Encyclopædia" from its predecessors—the number and beauty of the illustrations. Many of the old line blocks and wood engravings have naturally still great value, and where they have not been rendered obsolete or out of date, they have been retained; but they are supplemented by a wonderful series of half-tone plates, arranged clearly on both sides of the paper in order to save space, and containing, in some cases, as many as twelve or sixteen separate blocks to the page. For beauty of half-tone illustration it would be hard to beat the series of plates to the article on Greek art, while those to the article on gems, with their admirably clear classification, show what modern scientific illustration can achieve.

In the short account we have given of a single aspect of this great work, we have not attempted to criticise any article in detail, though in the course of our reading we have noted one or two slips. To select them for special mention from a work of such magnitude would be unfair, as it would tend to create a wrong impression. That so high a standard of accuracy should have been achieved is an eloquent testimony to the devotion of the editor, and of the distinguished band of specialists whom he numbers among his contributors.

L. W. K.

THE DATA OF PHYSICAL CHEMISTRY.

Physico-Chemical Tables, for the Use of Analysts, Physicists, Chemical Manufacturers, and Scientific Chemists. By John Castell-Evans. Vol ii., Physical and Analytical Chemistry. Pp. xiv+549–1235. (London: C. Griffin and Co., Ltd., 1911.) Price 36*s*. net.

THE second and concluding volume of Mr. Castell-Evans's work on physico-chemical constants is a veritable monument to the industry and perseverance of the author, who unhappily has not lived to reap the reward of his labours. The user of the tables may well be appalled at the magnitude of the task undertaken by a single compiler to bring out two volumes covering in detail the whole domain of physical chemistry and running in all to more than twelve hundred pages.

To review such a work adequately is almost impossible without keeping the book in hand for a longe[r] time than is desirable. The reviewer's criticisms mus[t] therefore be taken as indicative of the directions i[n] which a future edition might be improved, rathe[r] than as the results of a detailed examination; it shoul[d] also be noted that in the circumstances the reviewe[r] has refrained from raising debatable questions.

The distinguishing feature of the book is un[-]doubtedly the very large amount of labour put int[o] the calculation of the numerous tables, a great numbe[r] of which are quite new and contain data only obtain[-]able elsewhere from many scattered sources. Fo[r] example, the collection of data on viscosities and o[n] densities of liquids and their variation with tempera[-]ture are most useful and complete. To the analytica[l] chemist and assayer the two hundred pages of table[s] for shortening analytical computations, for the com[-]parison of volume and weight percentages, and fo[r] the conversion of the various systems of units employe[d] in such estimations, will be very valuable.

In the compilation of this second volume of table[s] even to a greater extent than in the first, the autho[r] seems to have allowed his extraordinary desire fo[r] high numerical accuracy to lead him to give th[e] values of constant in many cases to far more figure[s] than can possibly have any significance.[1]

As a sample physical measurement of the highes[t] class under the best possible conditions may be con[-]sidered the comparison of two similar platinum[-]iridium kilograms with all the refinements of a trans[-]position balance, a "complete" set of weighings, an[d] the utmost precautions. Under these conditions th[e] thousandths of a milligram may be said to hav[e] some significance. Similarly in length measurement[s] the difference in length between two similar standar[d] metres of the highest class may be determined to [a] few hundredths of a micron, and the height of [a] metre column of mercury to a few thousandths of [a] millimetre. The last significant figure in the thre[e] cases is $1/10^9$, $1/10^8$, and $1/10^6$ of the whole respec[-]tively. These are the most favourable cases, but i[t] seems unlikely that even with the best of methods a[n] interval of temperature can be measured with greate[r] precision than about one part in a hundred thousand[.] Besides, if instead of the mass or length chosen i[n] the examples an odd multiple of a fundamenta[l] standard be taken, the precision attainable may be onl[y] one-tenth of that given or even less.

But Mr. Castell-Evans gives many instances o[f] eleven and some even of fourteen significant figure[s] among his constants and conversion factors, wherea[s] for the purpose of avoiding mere errors of computa[-]tion the retention of one, or at most two, addition[al] places beyond the usual limits would have been ampl[y] sufficient.

While dealing with this question, it may be re[-]marked that a physicist familiar with the modern pre[-]cision measurements of physics, but whose ment[al] estimate of the kind of accuracy now attainable i[n] chemical work was obtained only from Mr. Castel[l-]

[1] The writer is informed that this retention of an unusually large numbe[r] of figures was not due, as might have been supposed, to the use of a calc[u]lating machine whereby the extra digits were obtained without any ve[ry] serious increase of labour, but that the numerical work was performed by th[e] author without the aid of any machine.

Evans's volume, would be very much astonished to be told that probably no single atomic weight is known to 0·01 per cent., and that comparatively few are certain to one part in a thousand. Indeed, it may almost be asserted that there is just as much a prevailing "fashion" in atomic weights as in that of wearing apparel. In view of the fact that laboratory chemistry may be said to have had a start of nearly a century upon laboratory physics, this great discrepancy in the precision attainable in the two sciences is not easy to explain, the difference being the more remarkable when the relative numbers of workers in the two fields are taken into account.

Possibly after all the theorising to the contrary the true cause may be found to be that all the atoms of a so-called elementary substance have not exactly the same weight.

J. A. HARKER.

PRACTICAL ASTRONOMY.

Text-book on Practical Astronomy. By Prof. G. L. Hosmer. Pp. ix+205. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd.; 1910.) Price 8*s.* 6*d.* net.

THOSE who have used Prof. Hosmer's previous work, "Azimuth," will remember that one of its most pleasing features is the unconscious display of the author's intimate acquaintance with the practical side of surveying and of teaching. The same pleasing feature is just as much a characteristic of the present work. One feels that there is but little of the subject that the author has not practised until the operations are almost part of a second nature, yet in this work he does not lose sight of the fact that the student is a beginner and needs telling that the sun-glass is not usually placed over the object-glass.

The order of treatment is the conventional one; the method of treating the subject is Prof. Hosmer's. In the early chapters he explains, with numerous simple diagrams, the real and apparent motions of the celestial sphere, gives a number of definitions, and then describes the common systems of coordinates, their interrelations, and the methods of converting quantities from one to the other.

The anomalies of our unscientific mixture of "times" are elucidated in the next chapter, and the student is shown by example how to obtain any one, knowing either of the others. In chapter vi. the American ephemeris is explained, but much of the matter would apply equally to the contents of our Nautical Almanac; the method of interpolation to get intermediate ephemeris values is simple, but Prof. Hosmer recognises that it is not so simple—to the student—as to need no explanation. After considering the figure of the earth and the corrections it renders necessary, the author proceeds to a chapter on instruments, where, after dealing with the engineer's transit, the sextant and the chronometer, he gives a brief and simple account of the zenith telescope and concludes with a characteristic paragraph (58) of hints and suggestions on observing; the hint as to the making of a permanent mark showing the focus on a frequently used surveyor's transit telescope illustrates how simple the author has made it for a beginner to "go right."

In the subsequent main chapters on the determination of latitude, time, longitude, and azimuth, we do not detect any novel methods, but we do recognise the simple conciseness of the instructions. By the use of smaller print the matter for a longer (advanced) course is differentiated from the simpler matter which would form a good first, or short, course—a hint that is valuable from such an experienced instructor. The formulæ employed are all numbered, so that in the case of transformations, or derivations, the student can readily refer back to his primary form.

The concluding chapter, on nautical astronomy, is chiefly notable for its excellently clear statement of Sumner's method illustrated by one or two useful diagrams. In an appendix the general question of tides is discussed briefly from the point of view of "level," and a number of useful tables of various astronomical quantities are given. The diagrams throughout are numerous, clear, and readily comprehensible.

THE MENACE OF THE HOUSE-FLY.

The House-fly—Disease Carrier: an Account of its Dangerous Activities and of the Means of Destroying it. By Dr. L. O. Howard. Pp. xix+312. (New York: Frederick A. Stokes Co., 1911.) Price 1.60 dollars net.

ALTHOUGH house-flies are universally admitted to be a nuisance of a peculiarly exasperating kind, it was not until almost within the last decade that even physicians, with a few isolated exceptions, began to realise the possible dangers lurking in the presence of the most familiar and probably most widely distributed of all insects. The Spanish-American war of thirteen odd years ago did something to direct attention to the importance of the house-fly as a carrier of enteric fever in military standing camps, and the lesson then borne in upon the medical officers of the United States Army was enforced only too well a few years later by our own experiences in South Africa. It is now agreed by those best qualified to judge that the house-fly can convey the causative agents of cholera and enteric fever, and in outbreaks of these diseases often plays no inconsiderable part as a disseminator. Whether or not it acts as a carrier of infantile diarrhœa, which during the summer months frequently causes great mortality among young children, is not yet conclusively established; but that it is capable of carrying tubercle bacilli is certain, and tuberculosis and the other diseases mentioned do not exhaust the list of what are at least *potential* dangers connected with the house-fly.

In the so-called "residential" quarters of cities, in countries such as our own, the house-fly has nowadays not much opportunity of becoming contaminated with disease-causing organisms, but, as has been shown by Prof. Newstead in Liverpool, and in Washington by the author of the volume before us, it is unfortunately otherwise in the dwellings of the poor. In villages and old-fashioned farmhouses, where sanitary arrangements are too often painfully primitive,

given a single case of enteric fever, the habits of the house-fly may easily cause an outbreak of the disease, which may have far-reaching consequences. As a potential disease-disseminator, at any rate, no other British insect is of anything like the same importance as the common house-fly; yet by the British public its potentialities are but dimly realised, if at all.

In the volume under review, which "is not intended to be a scientific monograph," Dr. L. O. Howard, a well-known authority, provides a convenient and altogether admirable summary of existing knowledge concerning the subjects mentioned in the title. The book is well arranged, simply yet forcibly written, excellently illustrated, and provided with a very complete "bibliographical list," while the results obtained by other workers down to the date of publication are duly noted in the text. With regard to the range of flight of house-flies—a subject of great practical importance—it may be mentioned that the observations of Copeman, Howlett, and Merriman, showing that the insects are capable of flying to a distance of more than 1400 yards, were published too late for inclusion. Only two comments seem necessary by way of criticism; in a subsequent edition, which we hope will be called for, Dr. Howard should correct the unfortunate slip on p. 18, where it is stated that the house-fly's eggs vary in length "from one-sixth of an inch to a little longer" (the real length being one millimetre or a little less), and should on no account omit to provide an index. If a hackneyed phrase may be pardoned, "The House-fly—Disease Carrier" "supplies a want," and a copy of it should not only find a place on the shelves of every medical officer of health and borough surveyor in the British Islands, but should also be included in every public library.

E. E. A.

MAN AND BEAST IN EASTERN AFRICA.

Man and Beast in Eastern Ethiopia: from Observations made in British East Africa, Uganda, and the Sudan. By J. Bland-Sutton. Pp. xii+419, with 204 engravings on wood. (London: Macmillan and Co., Ltd., 1911.) Price 12*s*. net.

THIS work has been prepared with considerable care, and the reviewer has no desire to be captious; but he feels bound to say that there is little in it which strikes him as being due to really original observations on the part of the author; nor are the illustrations (all of them woodcuts) particularly novel, or, in the case of beasts and birds, invariably accurate. They do not possess the truth of photographs taken direct from nature. Moreover, in regard to these illustrations, many are from photographs or drawings in other books; and even when the source of the original is mentioned (this is not always done), one asks oneself why they should be reproduced, since the original work is easily accessible in libraries.

In like manner, the text of the book is almost entirely made up by extracts or paraphrases from the published books or reports of H. M. Stanley, Joseph Thomson, F. Elton, Speke, F. C. Selous, H. H. Johnston, Newton Parker, J. F. Cunningham, various members of the Church Missionary Society, C. W. Hobley, R. J. Stordy, Mr. and Mrs. Hinde, W. S. Routledge, L. von Höhnel, A. H. Neumann, F. J. Jackson, Drake-Brockman, J. E. S. Moore, Donaldson Smith, and others, whom it would be tedious to enumerate. As an example of inappositeness the author has put in a drawing of *Cobus ellipsiprymnus*, the South African waterbuck; but he is obliged to explain that it is absent from the districts he is describing, where the form of waterbuck is *Cobus defassa*. The African lung-fish (Protopterus) is described as the Lepidosiren (the Lepidosiren being the representative of this order which is found in the waters of the Amazon and its tributaries in South America; the figures in the text, of course, are those of Protopterus).

These criticisms do not imply that the book is not an exceedingly interesting one for persons who are unacquainted with the natives, beasts, birds, and reptiles of eastern equatorial Africa. To those who desire a superficial acquaintance with this remarkable fauna it will certainly be of use, but to be perfectly fair, it must be taken as the summary of other people's work and other people's observations, and cannot be described, as it is on the title-page, as being based on observations made by the author, though undoubtedly the author's own journeys have taught him to appreciate the interest and the accuracy of the works published by his many predecessors.

H. H. JOHNSTON.

OUR BOOK SHELF.

(1) *A Compendium of Aviation and Aerostation: Balloons, Dirigibles, and Flying-machines.* By Lieut.-Colonel H. Hoernes. With a preface by J. H. Ledeboer. Pp. xi+179. (London: Charles Griffin and Co., Ltd., 1911.) Price 2*s*. 6*d*. net.

(2) *The Helicopter Flying-machine: an Account of Previous Experiments, including an Analysis of the Author's Turbine Machine.* By J. Robertson Porter. Pp. viii+80. (London: Aeronautics Office, 1911.) Price 3*s*. 6*d*. net.

(1) LIEUT.-COLONEL H. HOERNES has, under the title given above, produced a very readable popular handbook, and its low price and handy size should find it a ready market. Its chief value is as an historical record, the section dealing with dirigibles being particularly useful and giving a mass of important information in a small space. As may be expected from one whose name is well known as an authority on lifting-screws, the author declares emphatically for the helicopter as the machine of the future, and says: "In my opinion at least, the lifting-screw machine, or helicopter, forms an advance on every other type of flying-machine." The reasons for this statement are given as its capabilities for vertical rise, its lightness, strength, and ease in landing, its safety, trustworthiness, and ease in control.

(2) On the other hand, in "The Helicopter Flying-machine," Mr. J. R. Porter, who has devoted many years to the study of the subject, rejects the helicopter proper for what he terms a "turbine machine." The propellers in this apparatus are designed to produce a horizontal and radial current of air, which is diverted downwards by means of curved annular surfaces, with the result that an upward reaction is produced. It is his opinion that a helicopter proper "has less stability than the aëroplane, that the matter

of control brings a greater responsiblity on the pilot, and in case of the engine stopping the machine has no means of gliding safely to earth." Mr. Porter deserves great credit for the clear and concise way he has analysed the most important experiments with lifting-screws, and his book, which at present stands as the only English work on the subject, should find a place in every student's library.

Secrets of the Hills, and How Ronald Read Them. By Sterling Craig. Pp. 320. (London: George G. Harrap and Co., n.d.) Price 3s. 6d. net.

VERY early in the nineteenth century, the Rev. Isaac Taylor showed how a certain James and his father, Mr. Thompson, visited a series of British mines and compared them sagaciously with those of other lands. The little book, called "The Mine," in which the didactic Thompson and the preternaturally patient James were made to record their impressions, ran through three editions by 1831. At that date the Wicklow nugget of 22 ounces was the largest mass of native gold on record, while the mineral zircon was regarded as beyond the reach of an ambitious collector. Mr. Craig now comes forward with a similar book, published bravely in the twentieth-century manner in a very excellent type, and beautifully illustrated by photographs in place of the romantic old copper plates. Of course, when we were boys we loved Taylor's "Train of Mules bearing Copper Ore" in Cornwall, and the tufted Indians "Diamond washing at Golconda"; and our successors may equally delight in the realistic pictures of "Holing the Coal" (p. 202) and of the fossil bones at Pikermi (p. 306), which are so well provided by Mr. Craig. Mr. Craig's boy, Ronald, goes to stay with a well-informed doctor in the Leadhills, and receives even more instruction, in return for his judicious questions, than did the late lamented James.

Dr. Thomson—the name is, of course, a pure coincidence—keeps himself well abreast of geological literature, though we may not agree with him about the entirely mythical crystallised sea-sand so neatly figured on p. 30. His lucid but lengthy manner of discourse has proved contagious in the district, and is successfully imitated by Jim, a working miner, and by Mr. Holloway, of Dollar. But boy readers, to whom all this is new, will probably not regard such friends as tiresome. It is quite incorrect to think that young minds have no thirst for information, and even the adventurous will enjoy the graphic account of Ronald's work in a lead-mine underground. Mountain-building and river-erosion are described with the aid of sections, and the line-drawings in the book are for the most part as effective as the photographs. There are a few misprints, as "Unita" for "Uinta," and "Cornish" for "Coruisk," and some rather definite statements on matters that are a good deal in dispute. But the 320 pages contain a large range of information, and it is interesting to find that the Thompsonian (or Thomsonian) manner is still so much in favour.

G. A. J. C.

Laboratory Text-book of Embryology. By Prof. C. S. Minot. Second edition, revised. Pp. xii+402. (London: J. and A. Churchill, 1911.) Price 16s. net.

LABORATORY text-books are apt to be limited in their use, due, no doubt, to the fact that the teaching in two different laboratories is never identical. Their use will be the more extensive as the illustrations and text are made general in application.

The illustrations in this work are well executed, and in the new edition their number has been increased from 218 to 262. They are mainly taken from special sections and figures, but the sections and figures have been well selected as typical. Their value is much enhanced by the fact that they are faithfully drawn, and give, as much as is possible in black and white, the appearance of sections as seen under the microscope; too diagrammatic a section is apt to mislead a student. The reconstructions illustrated are valuable aids in giving a student a general idea of the anatomy of the embryo; they also help by showing where the sections illustrated are cut.

Besides additions to the illustrations, Prof. Minot has in this second edition entirely recast several chapters so as to make the study of development chronological throughout. The text is chiefly descriptive of the sections and figures, but short comparisons are drawn between the various stages. The introductory chapter deals with too much in too short a space to be of any real use. Heredity, for instance, when treated in a page leads one to believe that Darwin's theory of "Pangenesis" is the only theory worthy of consideration. Again, Prof. Minot's classification of glands, when proposed so shortly, is liable to confuse.

As in the old edition, the pig is the basis of study, since in America pig embryos above the length of 6 mm. can readily be obtained from abattoirs. For the early stages the rabbit is used. Human embryology is treated at some length, well-known figures being used for the purposes of illustration. The chicken is only allowed forty-four pages out of a total of 402, so that the work treats almost entirely of mammalian anatomy.

The practical directions at the end of the book supply the details of formulæ and give methods for staining and reconstruction.

Photograms of the Year 1911–1912. Edited by H. Snowden Ward. Pp. 154. (London: George Routledge and Sons, Ltd.; Dawbarn and Ward, Ltd.; New York: Tennant and Ward; Melbourne: Kodak (Australasia), Ltd.; Toronto: The Musson Book Co., Ltd., n.d.) Price 2s. 6d. net.

THIS annual deals chiefly with descriptions and criticisms of the "pictorial" photographs exhibited in the various exhibitions, and brief summaries of the state of pictorial photography in other countries. Mr. Robert Demachy speaks for France, and concludes that there is sounder work going on there. South African progress is recorded by Mr. George E. Whiting, and he deplores the ending of the *Journal of Photography* published there, but rejoices at the formation of two new societies. The work in Germany is taken in hand by Mr. F. Matthies-Masuren, while Mr. Walter Burke's remarks are devoted to Australia. The main portion of the book is, however, from the pen of the editor, who, as was announced in NATURE of December 14, died early in that month in New York. Mr. Snowden Ward's contribution consists in the main in describing the special features of the very large collection of the works exhibited at various places during the past year, and this will be found very useful to those who take up this, the pictorial, side of photography.

The book, as usual, is profusely illustrated, and the fact that many of the pictures have not been seen in this country before adds a special feature to them. There is no doubt that pains have not been spared to reproduce well the pictures contained in the volume, but there are some, notably that entitled "When all the snowy hill and the bare trees are still," which seemed scarcely worth the trouble taken. Many readers will find in the book much that is both amusing and useful.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Weather of 1911.

I HAVE received the subjoined letters from Dr. Schmauss at Munich, which may be of interest to your readers. In England in December, 1911, the temperatures up to 8 km. were decidedly below the mean. This is nearly always the case in stormy weather.

In the following table the correlation between the general drift of the atmosphere and the temperature is shown.

N denotes the north component of the drift of the balloon, the positive direction being the north.

E, the drift to the east.

T_0, the surface temperature.

T_4, the temperature at a height of 4 km.

T_8, the temperature at a height of 8 km.

H_c the height of the commencement of the isothermal column.

The observations in England were taken during the four years 1908 to 1911 on some eighty different days. Owing to the practice of the International Commission of nearly always fixing the week for daily ascents in the summer, the preponderance of the observations lies in the summer. Since observations made at neighbouring stations on the same day cannot be considered independent, and since large groups of observations are concentrated into particular weeks, during some of which unusual conditions prevailed, the probable errors are really far larger than the number of observations would indicate.

Correlation Coefficients.

	English. Four years			Continental One year
	Winter	Summer	Combined	
E and T_0	0·18	0·07	0·13	−0·12
E ,, T_4	−0·17	0·12	0·07	−0·28
E ,, T_8	−0·08	0·17	0·16	−0·26
E ,, H_c	−0·31	0·08	−0·09	−0·08
N ,, T_0	−0·16	−0·01	0·18	0·26
N ,, T_4	−0·13	−0·16	0·10	0·18
N ,, T_8	−0·17	0·00	0·06	0·21
N ,, H_c	−0·26	−0·11	−0·06	0·04
H_c ,, T_0	0·22	0·42	0·43	0·49
H_c ,, T_4	0·60	0·57	0·67	0·75
H_c ,, T_8	0·75	0·72	0·71	0·76
No. of obs.	(46)	(93)	(139)	(80)

It will be seen that the only correlation coefficients large enough to be significant are those showing the connection between the height of the isothermal and the temperatures.

Dr. Shaw's hope, expressed in your issue of December 21, 1911, seems to be fulfilled, for were there any close and systematic connection between the temperatures and the direction of the air currents, or between the latter and the height of the isothermal, it could scarcely fail to appear in the figures. The small values of the coefficients (0·31, with a probable error of 0·1, even if we treat all the observations as independent, is the largest) and the want of agreement between the different groups both lead to the conclusion that there is no connection, or at the best a very slight one.

The connection between the height of the isothermal and the temperature of the air below down to 4 km., and perhaps even to the surface, is very plainly shown, and makes me regret my somewhat rash statement that the surface temperature was more dependent upon the direction of the wind than upon anything else.

The negative value of −0·16 between T_0 and N is certainly curious, and the sign would probably be reversed if there were some hundreds of observations instead of forty-six; but the drift of the balloon is not necessarily the same as the direction of the surface wind, although, as a general rule, especially when the wind is strong, the two agree fairly well. The negative sign indicates that a south wind is colder than a north, and must be taken as a warning not to ascribe any significance to small correlation coefficients.

W. H. DINES.

December 30, 1911.

Kgl. bayer. meteorologische Centralstation, Munchen, den 11 Dezember, 1911.

Es wird Sie im Anschlusse an Ihre Mitteilung in NATURE 88 S. 175 interessieren zu hören, dass unsere September-fahrten über München nahezu die gleichen Verhältnisse aufweisen wie Ihre britischen Aufstiege.

Es war die Temperaturabweichung vom Mittel:—

516	1	2	3	4	5	6	7	8	9	10	11	12	13 km
+2·9	+4·3	+5·7	+4·4	+4·3	+3·4	+2·3	+2·3	+2·2	+2·4	+1·0	−3·4	−7·4	−6·9

Munchen, den 27 Dezember, 1911.

Auch noch die Dezemberaufstiege haben eine ähnliche Abweichung über München ergeben. Es wurden die Werte der drei Dezemberaufstiege gemittelt und die Abweichungen vom Mittel gebildet.

Es war dieselbe:—

In	1	2	3	4	5	6	7	8	9	10	11 km
	+3·7	+6·3	+5·5	+5·0	+4·0	+4·0	+5·8	+5·7	+3·1	−0·1	−3·3

Der grosse Wärmevorrat der Atmosphäre in diesem Herbste ist darin deutlich ausgesprochen.

A. SCHMAUSS.

SIR EDWARD FRY has asked (NATURE, December 21, 1911, p. 244) whether the unusually warm weather that prevailed in Western Europe last summer extended over the whole earth. It is possible to answer in the negative so far as Egypt is concerned, for the temperature here was below average from June to September. Indeed, on some days London had a higher maximum than Cairo, e.g. August 9, Greenwich 100°, Cairo 93°. The result was a retardation of the cotton harvest by some twenty days in the first picking.

As regards the cause of the cooler weather, there is a certain amount of evidence that the amount of solar radiation reaching the lowest stratum of the atmosphere here was less than usual, if any faith is to be placed in the indications of the black-bulb thermometer *in vacuo*. The phenomenon, of course, may be due either to diminished solar activity or to locally increased absorption in the upper strata, or to a combination of both. In any case, Sir Edward Fry's original query brings us face to face with what is probably the ultimate question in meteorology: given unit increase of solar radiation, calculate the effect at the earth's surface. The solution will not be identical for all parts of the earth, and so a small and temporary diminution of radiation may at one place cause increase of temperature, while at another the reverse is the case.

J. I. CRAIG.

Giza, Egypt, December 31, 1911.

English *v.* Continental Microscope Stands.

REFERRING to the interesting article on the merits of English *versus* Continental Microscope Stands in NATURE of December 21, 1911, I notice that whilst reasons are given on both sides for the distinctive peculiarities of the respective models, and a general suggestion is made as to how the present well-recognised types have come about, curiously enough, no reference has been made to what seems to me to be the real origin of the most important differences between the two types—I refer, of course, to the substage arrangements as a whole. Why is it that the English model provides for the exact centring, and frequently for fine adjustment focussing of the substage optical system, whilst the Continental model does not? Why is it that the Continental models, on the other hand, provide rackwork mechanism for moving the iris diaphragm of the condenser out of centre, with means for rotating this whole arrangement—a feature absent in the English model?

These things are clearly the outcome of the different theories which prevailed at one time in England and Germany on the question of microscope illumination. On the Continent, it must be remembered, the general recognition of the utility of substage condensers dates from the time when Abbe worked out his epoch-making theory

the microscope image. But, fruitful as that theory immediately was in so many respects, it led Abbe in the first instance, as we now know, to undervalue the importance of the substage illumination in certain aspects, for which statement the fact that only a chromatic form of condenser was originally supplied is sufficient evidence. Further, as is well known from the controversies at the time, it led Abbe at first to favour a narrow cone of light from the substage condenser. Thus the latter became merely a tool by which the object might be studied by means of a beam or pencil of light impinging on it at various degrees of obliquity and in different azimuths.

The Continental substage was designed for this purpose; indeed, it has been explicitly stated by Prof. H. Ambronn[1] (*Zeitschrift für Wissenschaftliche Mikroskopie*, January, 1905) that the construction of the illuminating apparatus named after Abbe, and of which the arrangements connected with the diaphragm carrier constitute the chief novelty, was really only designed by its originator for the testing of objectives and for experiments on the effects of diffraction.

Strange to say, although it is a long time since the utility of achromatic condensers and wide illuminating cones for general microscopic observations has been recognised on the Continent, most Continental makers still cling to the old form of substage construction, preferring to modify other arrangements to adapt them to this construction rather than change their model.

In England, substage illuminators were in general use long before this was the case on the Continent; originally they were looked upon—as the name "condenser" implies—simply as a means of concentrating light on the object; but at the time when Abbe brought out his theory of microscopic images, the value of precise centring arrangements for the condenser and the use of wide-angled cones of light had been so well recognised by Nelson and others that the new theory did not induce English microscopists to recede from their previous experience in these respects. On the contrary, it led in this country to a campaign on behalf of the wide-angled cone of light from the condenser, and the mechanically moveable iris diaphragm was not adopted by English makers. The simpler method of the shallow carrier above the iris diaphragm, into which stops for dark-ground illumination, for oblique illumination, or various stops for experimental purposes could be dropped, was found to render all the service necessary. Hence the general lines on which the construction of the present-day English substage arrangements have developed.

Those who have worked with both forms will be in little doubt as to which is the more convenient.

JULIUS RHEINBERG.

London, December 30, 1911.

The Photography of Hα during Solar Eclipses.

WITH regard to Mr. Butler's letter on this subject (NATURE, vol. lxxxviii., No. 2199, p. 244), I may say that I was unaware that Hα had been photographed in the "flash" spectrum in former total solar eclipses. As I have also been, so far, unsuccessful in my search in the preliminary reports of the eclipse observers of 1893 and 1898, in the Proceedings and in the Philosophical Transactions of the Royal Society, in finding any specific mention of Hα, would Mr. Butler kindly supply the needed references? I may add that in the photograph taken by Father Pigot under my direction in the last eclipse, Hα does not appear as an isolated arc, such as might be recorded on an isochromatic plate, but as the strongest impression crossing a continuous band which extends from Hα well into the ultra-violet. A modification of my original statement in this sense might meet Mr. Butler's criticism.

A. L. CORTIE.

IN reply to Father Cortie's note, I give the detailed references he requires, abstracted from the papers mentioned in my previous letter:—

(1) *Total Eclipse of the Sun*, April 16, 1893.
Phil. Trans., A, 187, pp. 551–618, 1896.

[1] *Vide* also Journal of the Quekett Microscopical Club, 1905, pp. 157–8.

P. 574.—On negative 17 the image of Hα was obtained even at mid-eclipse, although the plates were not specially sensitive to red.

P. 617.—The line Hα is indexed in the table of chromospheric lines as having been recorded on three photographs, Nos. 17, 18, 19. On No. 19 it is given as intensity (3) on a scale of 10, which is quite remarkable considering that the plate employed was not specially red-sensitive.

(2) *Total Eclipse of the Sun*, January 22, 1898.
Phil. Trans., A, 197, pp. 151–227, 1901.

P. 199.—The line was so prominent that it was utilised for wave-length determinations.

"For the purposes of reduction the spectrum has been divided into two parts, one extending from Hα in the red to λ 3900 in the violet. . . ."

P. 226.—In the table of chromospheric lines determined from photographs, the line Hα is given as intensity (5) on a scale of 10. The plates on this occasion were isochromatic, but still not specially red-sensitive, and the greater relative intensity of the image of Hα compared with that on the 1893 plate is probably due to this.

Plate 6, spectrum strips *a* and *b*.—Inspection of these two strips will at once show the presence of Hα as a strong line; in fact, the best description of it is exactly similar to that given by Father Cortie for the impression on Father Pigot's plate. It is the strongest impression (in that region) crossing a continuous band which extends from (beyond) Hα well into the ultra-violet.

One of the other results to which I referred is that given in the report by J. Evershed, "Wave-length Determinations, &c., at the Solar Eclipse, January 22, 1898."
Phil. Trans., A, 197, pp. 381–413, 1901.

P. 410.—Hα strong on No. 7 plate.

P. 413.—Spectrum No. 7 (Hα).

Plate 11, Fig. 5, Spectrum No. 7.—Hα shown and lettered as a strong line.

CHARLES P. BUTLER.

Meteor-showers.

THE following meteor-showers become due during the remaining part of January:—

Epoch January 11, 20h. 30m., twentieth order of magnitude. Principal maximum, January 13, 21h. 20m.; secondary maximum, January 12, 1h. 45m.

Epoch January 15, 9h. 30m., second order of magnitude. Principal maximum, January 14, 21h. 50m.; secondary maximum, January 14, 3h. 30m.

Epoch January 15, 4h. 30m., approximately fourth order of magnitude. Principal maximum, January 15, 12h.; secondary maxima, January 16, 16h. 10m., and January 17, 7h. 25m.

Epoch January 21, 18h., approximately eleventh order of magnitude. Principal maximum, January 20, 19h. 30m.; secondary maxima, January 19, 0h. 5m., and January 21, 3h. 35m.

Epoch January 22, 8h., thirteenth order of magnitude. Principal maximum, January 23, 14h.; secondary maxima, January 23, 2h. 50m., and January 24, 3h. 50m.

Epoch January 26, 11h., approximately eleventh order of magnitude. Principal maximum, January 27, 13h. 15m.; secondary maxima, January 24, 14h. 20m., and January 27, 10h. 30m.

Epoch January 26, 19h. 30m., thirteenth order of magnitude. Principal maximum, January 28, 1h. 5m.; secondary maximum, January 28, 8h. 40m.

Epoch January 30, 0h., approximately twenty-eighth order of magnitude. Principal maximum, January 30, 8h. 40m.; secondary maximum, January 31, 11h. 20m.

There is a considerable degree of meteoric activity in the latter half of January. The most important days during the period January 9–31 are January 14–15, January 16–17, January 20–22, January 24–28, and January 30–31. The most noteworthy epoch of this period is that of January 26, 19h. 30m., as it resembles in type that of November 17, 1911, 3h. 30m., to which attention has previously been directed. The epoch January 15, 9h. 30m., comes next in importance as a slight variant of the same type, though its intensity is apparently much greater.

Dublin, January 8.

JOHN R. HENRY.

Explosive Hail.

On the afternoon of November 11, 1911, there was a brief storm of explosive hail at this place.

The morning had been unseasonably warm; about noon there were the usual signs of a coming thunderstorm—heavy cumulo-nimbus clouds with a gusty wind—which began about 2.30 p.m. with a slight shower of heavy raindrops; shortly afterwards there were two or three flashes of lightning and thunder, followed by a fall of large hailstones, which on coming in contact with the windows or walls or pavement in many instances exploded with a sharp report, so loud as to be mistaken for breaking window panes or a pistol shot. As the hail fell, the fragments sprang up from the ground and flew in all directions, looking like a mass of "popping corn" on a large scale.

The fall lasted two or three minutes, about half the hailstones being shattered, the ground in some places being nearly covered white with the stones and fragments.

Of the unbroken stones, seventy were gathered. They weighed, roughly, 225 grams. A few were ellipsoidal, the longest axis about 25 mm. in length; most of them, however, were nearly spherical, and somewhat smaller, from 15 to 20 mm. in diameter.

Practically all of them contained a nucleus. In a few of the stones the nucleus was porcelain-like, raspberry-shaped, surrounded by almost colourless spherical layers of ice, for about five-sevenths of the diameter, and then a shell of porcelain-like, snowy ice.

A fair proportion of the stones showed, in addition to the spherical, a radiate structure, which was very apparent as the stones melted in a flat dish, showing the cross-section with great distinctness.

The writer noticed a similar fall of explosive hail about eighteen years ago at Lexington, Virginia. The stones in this fall were much smaller, and attention was directed to the stones by the peculiar way in which they seemed to rebound on striking the ground, which was also due on that occasion to their breaking into fragments, without, however, any noticeable explosion.

W. G. Brown.

University of Missouri, Columbia, Mo.,
December 27, 1911.

THE BEGINNING OF ARCTIC EXPLORATION.[1]

THESE two great volumes take up the knowledge of the northern regions from the dawn of history, and starting from Homer they have only reached the voyage to Newfoundland of Gaspar Corte-Real in 1503. The reason for this is thus explained, not in the preface, but in the "Conclusion":—

"If we would discover how a watercourse is formed, from the very first bog-streams up in the mountain, we must follow a multitude of tiny rills, receiving one fresh stream after another from every side, running together into burns, which grow and grow and form little rivers till we come to the end of the wooded hillside and are suddenly face to face with the great river in the valley below.

"A similar task confronts him who endeavours to explore the first trickling rivulets of human knowledge: he must trace all the minute, uncertain, often elusive beginnings, follow the diversity of tributaries from all parts of the earth, and show how the mass of knowledge increases constantly from age to age, sometimes reposing in long stretches of dead water, half-choked with peat and rushes, at other times plunging onward in foaming rapids. And then he too is rewarded; the stream grows broader and broader, until he stands beside the navigable river."

Dr. Nansen takes us with him as he traces the head streams of the earliest knowledge of the north in the misty uplands of the past, and leaves us just where the historian can advance with some assurance. He points out how the early peoples had vague ideas of shadowy regions on the edge of the habitable world-disc, and how, though now and again a voyager placed solid facts on record, such details as were current regarding the northern lands were for the most part a mixture of legend and myth. The writers who have dealt with the history of Arctic exploration hitherto have usually commenced with the search for the north-west and the north-east passages which supplied a powerful and intelligible motive for centuries of struggle. This record concludes before that motive came into play; but a book on the history of exploration without some clue of continuous human interest would be a weary chaos of random incidents, which no reader would willingly face, and Dr. Nansen finds a unifying clue in the persistent, romantic, and ever-hopeful search for the Fortunate Isles, which lay or drifted throughout the mistiest periods of history just on the verge of the known world. The guiding principle for the elucidation of the beginnings of exploration seems to be implied in this piece of psychology.

"For one thing, man's power of grasping reality varies greatly; in primitive man it is clouded to a degree which we modern human beings can hardly understand. He is

The conception of the northern and western lands and islands in Norse literature. From "In Northern Mists."

as yet incapable of distinguishing between idea and reality, between belief and knowledge, between what he has seen and experienced and the explanation he has provided for his experience."

Dr. Nansen proceeds to retell the old stories with this distinction always in his mind, and in the endeavour to separate fact from expectation he finds a way of escape from the clamour of the partisans who have so frequently made out the dim heroes of early voyages and their first chroniclers to be either paragons of veracity and precision or shameless and aimless liars. There is an appeal to the most authentic versions of the early narratives, many of which are given in these pages more completely than ever before in translation, and there is a minimum—we had almost said an absence—of controversial statements directed against the holders of contrary views.

It should be explained that the quotations from early authorities are all in translation, and the very interesting maps or portions of maps which are reproduced are translations also in so far as they are not facsimiles, but representations of the meaning of the maps, in many cases without the conventional repre-

[1] "In Northern Mists: Arctic Exploration in Early Times." By Prof. F. Nansen, G.C.V.O. Translated by A. G. Chater. Vol. i., pp. xii+384; Vol. ii., pp. iv+416. (London: Wm. Heinemann, 1911.) Two volumes, 30s. net.

sentations or the networks of compass lines which make the originals often both indistinct and confusing. Thus Dr. Nansen does not invite criticism of his interpretation of documents except from the very few who have made a special study of one or other of the many lines of literary or cartographic investigation with which he deals. Our knowledge of Dr. Nansen's character and of the fact that he went into the enormous labour of this work without prejudice or prepossession gives us confidence in the soundness of his conclusions.

The early history of the north, apart from vague poetical allusions, rests upon only a few definite authorities. The first is Pytheas, the Phocean colonist in Massalia, who first ventured northwards in the Atlantic, about 330 B.C., circumnavigated the British Isles, and reached Thule; he was also the first navigator to fix positions by astronomical determinations of latitude by means of a gnomon or by ascertaining the length of the longest day. Dr. Nansen goes fully into the question of the position of Thule, and satisfies himself that it was not Shetland or Faroe or Iceland but Norway. The next definite information was the description given to King Alfred about 890 A.D. (by the Norwegian walrus-hunter Ottar) of the rounding of the North Cape, the entry into the White Sea, and the phenomenon of the midnight sun. This was obviously a truthful narrative of personal experience. Then came Adam of Bremen about 1070, who collected a great deal of authentic information regarding Scandinavia, and mentions Iceland, Greenland, and Wineland, the two last-named for the first time in literature; but there is also much of the fabulous in his writings derived from classical legends. Contemporaneously with the chroniclers, and in the centuries between them, there were two vague currents of northern exploration regarding which such knowledge as has emerged is of the mistiest. They were those of the Irish monks, who founded a chain of settlements from the Hebrides to Iceland and carried with them legends of Hy Breasail—the Isle of the Blessed or the Fortunate Isles of the Greeks—of which many adventurous souls went in search; the finding of which was often rumoured but never confirmed. The second current was that of the Norsemen, who sailed westward to Iceland, where they found Irish monks residing, and whence, pushing westward still, they reached and colonised southern Greenland.

The old Icelandic sagas speak, as is well known, of a voyage of Leif Ericsson, when he missed Greenland and sailed westward until he met a coast, parts of which were named Helluland, Markland, and Wineland the Good, where self-sown wheat and wild vines were found, and various remarkable encounters took place. Hitherto the sagas have been accepted as faithful tradition enshrining facts of observation, but the outcome of a prolonged examination of all possible data is to convince Dr. Nansen that the wheat, the vines, and many other features were mere products of expectation on the part of the saga-tellers. He allows that Norsemen did reach the American coast (though we must say that his iconoclastic logic, if carried further, seems to us capable of throwing doubt on the authenticity of this part of the narrative too), but he believes that they thought they had reached the Fortunate Isles spoken of by the Irish monks and the Roman legends, and so attributed all that the Fortunate Isles were supposed to be to the lands of their discovery.

The idea that Wineland, though reached from Greenland, lay so far along the rim of the world-disc that it was close to Africa brings it in line with the Mediterranean legend, and presented no difficulty to the mediæval geographers before the revival of the spherical form of the earth and the invention of portable instruments for the astronomical determination of latitude. The growth of knowledge of cosmography and of precision in cartography is traced down to the time of the Cabots and the Corte-Reals, and the period of commercial whaling on the small scale which led the northern seafarers to the edge of the arctic ice is touched upon; and then, when the globe had been swept clear of myth and the Fortunate Isles had gone to Davy Jones with the Sunken Land of Busse, Dr. Nansen leaves us with the stage free for modern exploration. What he said of the explorers of that sixteenth-century stage we may say of those of our twentieth-century stage, when the passages have been found and the pole itself reached—

"To riches men have seldom attained, to the Fortunate Isles never; but through all we have won knowledge."

H. R. M.

MICROSCOPE STANDS.[1]

II.

THE CHANGES NOW GOING ON.

In discussing the relative merits of Continental *versus* English pattern microscopes, the ground is at once cleared if we discard the labels Continental and English, and seek a more accurate definition for each type than merely the place of origin.

As a matter of fact, the old labels will soon cease to have any real meaning, for the Continental makers are adding to their patterns new instruments, rivalling in complexity of adjustments the so-called English type, and English makers are in many instances producing almost exact replicas of the Continental type. That the foot still remains of a more or less horseshoe form, with inclination axis below the stage, in the one, and is generally of the tripod form with inclination axis above the stage in the other, is a detail which does not affect the real difference between the two types, viz. relative complexity, although it renders the former more suitable for use in the vertical, and the latter more comfortable for use in an inclined position.

The English type of microscope, owing to the fostering care of a small body of dilettanti, came into general notice, when the need of a microscope was felt by the professions, already a complex instrument; from this simpler types have been slowly evolved, too slowly unfortunately for the demand, which has in consequence swung over to the Continental type, which, having no past to speak of, was able to adapt itself the more readily to the wants of those who did not care so much how they saw, so long as they could see.

The two types, starting from opposite poles, have lately reached common ground as regards the majority of the instruments produced, and there is little to choose between them for mere demonstration of known structure; but to get the finest results out of any optical system centration along the axis, and in the case of a microscopical system interchangeability of parts not only above but below the stage is essential, and few Continental microscopes possess the means of doing this, while every English stand of the first class is so provided.

Therefore the conclusion of any unbiassed observer must be that the English type is the better in the hands of the expert, who wishes not merely to demonstrate the known, but to reach out maybe into the unknown; but what is best for the master of his instrument and subject is not always good for the average man, and

[1] The first article appeared in NATURE of December 21, 1911.

there are minor details, such as the method of fixing the mirror, &c., in the Continental pattern which make them easier of use by those who merely look on the microscope as a tool; and this, combined with the greater handiness in the vertical position when wet preparations are under examination, makes the Continental type more acceptable to the laboratory worker.

Such, in the writer's opinion, are the differences between the two types considered from a general point of view. We can now draw nearer, as it were, and examine each type in detail; and, curiously enough, although the conclusion drawn above was that, for the laboratory worker at any rate, the Continental is the better type, on account of greater simplicity, &c., yet the Continentals, in their more costly instruments, are greater offenders as regards redundances than the English, the differences in the two types being not so much that one is practically perfect, while the other is not, but that the errors and superfluities in the Continental type are passive—that is to say, they are there, but need not be used, and if used unknowingly make very little difference; while the defects in the English type, if fewer, are more vital, in that the efficient working of the instrument is interfered with if they are not mastered.

Taking first the Continental type, most of the better instruments are fitted with a circular rotating and centring stage, the use of which for anything but petrology it is difficult to guess; the iris diaphragm, below the Abbe condenser, is also fitted with an excentric rotating movement, which will, of course, give oblique light in any azimuth, but as oblique light is altogether discredited, except for certain experimental and lens-testing purposes, it can scarcely be considered a useful adjunct to the average microscope. So much for redundances. The instruments with this type of substage usually possess a mirror which is fixed as to its centre, but which can be inclined in any position about that centre. This is as it should be, as when mounted in this way it is easier for the average worker to illuminate properly; but such mirrors are usually fixed, not on the tailpiece, but on the part that slides in the tailpiece groove, thus altering the position of the mirror when focussing the condenser, which, when using a small source of illumination, such as a lamp, is a disadvantage, but a very minor one, compared with the swing tailpiece on which the mirror is mounted in most of the cheaper forms of the Continental type, and practically all patterns of the English type. The one advantage of the swing tailpiece is, of course, that oblique light can be obtained by its aid, a very doubtful advantage, as indicated above, and far too dearly bought by adding an adjustment that invariably puzzles the average man, and leads to more bad microscopy than all the other faults of either type put together.

In the writer's opinion, it is the combination of the altogether undesirable swing tailpiece with the desirable (if understood) centring substage, that has caused the prejudice (for such it amounts to) in certain quarters against the English type.

The first should be done away with entirely; the second, except for instruments used for amateurs, with almost as many condensers as objectives, should also be conspicuous by its absence, the centring nosepiece, or objective changer, such as made by Zeiss or Leitz, being a much more practical method of centring for the laboratory worker, who almost invariably uses only one condenser.

A BIRD-BOOK FOR YOUNG PEOPLE.[1]

WITH the assistance of Mr. A. R. Horwood, of the Leicester Museum, who has written the first seventy-eight pages dealing with bird photography, collecting eggs and skins, mounting the latter, and nature-study generally, Mr. Westell has succeeded in producing a very readable little volume. It is also rendered more attractive by the photographic illustrations, many of which appear to be from nature, although others are obviously "faked." The author treats his subject from the point of view of environment, discussing in turn the birds of the garden, the lane, the field and meadow, the air, the woodland, the heath, moor and mountain, the riverside, and the coast. That such an arrangement has a certain advantage from the point of view of the collector is sufficiently obvious, and in the opinion of the author it does not apparently outweigh difficulties that arise from the systematic point of view.

As regards systematics, the author, with the aid of Mr. A. R. Thompson, gives, in the form of an appendix, a list of British birds brought, so far as

Wheatear and Nesting-hole under Rock. From "The Young Ornithologist."

possible, up to date, with their scientific names. This is based on one recently compiled by Mr. Ogilvie Grant, but with some modifications in the sequence of the orders, which, in our opinion, are no improvement, since, whatever may be popular views on the subject, British orders of birds ought undoubtedly to commence with the passerines and end with the game-birds. In the matter of generic and specific names it is satisfactory to find that the author takes a conservative course.

It has, however, to be mentioned that the systematic list does not in all cases tally with the text. For instance, we find on p. 165 of the latter reference to one species of coal-tit, whereas two, the British and the Continental, are mentioned in the former, and it is accordingly a difficult matter for the young collector to identify which is described. That they are not really two species is immaterial. It may also be mentioned that no mention is made in either place of the Irish coal-tit, recently described by Mr. Grant. A word must also be said in regard to the index.

[1] "The Young Ornithologist: a Guide to the Haunts, Homes, and Habits of British Birds." By W. P. Westell. Pp. xv+311. (London: Methuen and Co., Ltd., 1911.) Price 5s.

We happened to want to see what the author had to say about the partridge, and naturally turned to the letter P, where no such name occurs. At last we find the bird, together with several other species, under the entry "Common," which, to say the least, is absurd. In fact, the prefix of "common" to *the* partridge is not required at all. R. L.

ADMIRALTY REORGANISATION.

THE official memoranda published by the First Lord of the Admiralty on January 8 are of great interest, but that relating to the Naval War Staff is of much greater importance than the other two. Mr. Churchill discusses at considerable, if not unnecessary, length the distinctions which he believes to exist between "naval and military problems," apparently considering it necessary to justify differences of organisation which will be found at the Admiralty and at the War Office when the new scheme has been developed. The First Lord is an able and forcible writer, who might be expected to state his case well, but it may be questioned if it would not have served his purpose better and have given a clearer understanding of the subject to the public if his memorandum on the Naval War Staff had been less diffuse. The fact is admitted by him that "during the course of years all or nearly all the elements of a War Staff at the Admiralty have been successively evolved in the working of everyday affairs." The edifice is now to be completed and crowned by combining "these elements into an harmonious and effective organisation." It is proposed "to invest the new body with a significance and influence which it has not hitherto possessed, and to place it in its proper relation to existing powers." This is obviously both wise and necessary action; but it is scarcely to be described as such a radical change as some persons have asserted.

In the current Navy Estimates provision is made for a Naval Intelligence Department and a Naval Mobilisation Department, each under a naval director (rear-admiral or captain), the former department including twenty-one naval officers and thirteen civilians, the latter six naval officers and four civilians. The total cost of these departments is about 22,000*l.* per annum. Both departments are placed under the First Sea Lord, and their duties are sufficiently indicated by their names. In the new scheme they will continue in existence, and a third section is to be added, to be known as the "Operations Division," and to be placed under a director. All three sections are to be combined together under a chief of the staff, who is to be "a flag officer, primarily responsible to the First Sea Lord, and working under him as his principal assistant and agent." "Constant, free, and informal intercourse between [the three sections] is indispensable"; and it is laid down that each of the directors is "to be kept fully acquainted with the work of their two colleagues."

All this is admirable, but the principles involved are in no sense novelties at the Admiralty; nor is it conceivable that the consideration of "war plans"—which is stated to be the special business of the new section—has not been practised at the Admiralty hitherto. Long-continued peace has tended to drive somewhat into the background the primary importance of a scientific study of operations and preparation of "plans of campaign," but it is well known that the great shipbuilding programmes which have been carried out during the last twenty-five years have been based—as they ought to have been—on strategical plans prepared by the Admiralty for the naval defence of the British Empire, its commerce and communications. While this is true, it is equally true that the enormous increase of the Royal Navy, the growth of rival war fleets, and the present complex conditions of naval warfare, have all emphasised the need for greater attention and closer study of the subject by competent persons. Consequently there can only be universal and hearty welcome of the endeavour now made to meet the pressing necessity by the development of an advisory War Staff at the Admiralty.

NOTES.

M. LIPPMANN has been elected president of the Paris Academy of Sciences for the present year, and Prof. Guyon vice-president.

THE Academy of Sciences of the Royal Institute of Bologna has awarded the Élie de Cyon prize of 3000 lire for 1911 to Prof. E. A. Schäfer, F.R.S., of Edinburgh, for his work on the ductless glands, and especially for his recent work on the pituitary body.

IT is proposed to establish in Dartmouth a permanent memorial to Thomas Newcomen, known for his work in connection with the steam engine, who was born in that town in 1663. A meeting of persons interested in the matter was held yesterday in the Dartmouth Guildhall. The Mayor of Dartmouth, Mr. Charles Peek, and Mr. T. F. Caston, the honorary secretary to the Newcomen Memorial Committee, will welcome suggestions as to the best manner of perpetuating the memory of the inventor and his invention, and be glad to receive contributions.

THE council of the Royal Sanitary Institute offers the Henry Saxon Snell prize for competition this year. The prize was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is to be awarded by the council at intervals of three years, the funds being provided by the legacy left by the late Henry Saxon Snell. The prize will consist of fifty guineas and the silver medal of the institute, and is offered for an essay on "Suggestions for Improvements in the Ventilating, Lighting, Heating, and Water Supply Appliances and Fittings for an Operating Room and its Accessory Rooms for a General Hospital of 400 Beds (no Students)."

AN influential body of gentlemen interested in the preservation of our local antiquities has presented a memorial to the committee now engaged in considering schemes for the future utilisation of the Crystal Palace and its grounds, suggesting the establishment of a National Folk Museum. The nearest parallel to the proposed institution is the Northern Museum at Stockholm, with its offshoot the Open Air Museum at Skansen. The scheme suggests the erection in the Palace grounds of a series of typical ancient houses, each provided with appropriate gardens and furniture, and an open-air amphitheatre for pageants, folk-songs, and dances. Part of the main building of the Palace might, the memorialists suggest, be devoted to exhibits of domestic art products, toys and games, a folk-lore room, a museum relating to the Royal House, and other exhibits illustrating the origin and evolution of the various departments of national culture. Something of the kind has been attempted in the Pitt Rivers Museum at Oxford, and the educational value of the culture series arranged by Mr. H. Balfour supplies good evidence in support of the present proposals. The domestic appliances of past times are now disappearing so rapidly that unless active steps are taken at once it will soon be impossible to supply the exhibits needed for a folk museum such as that now suggested.

By the death of M. Radau on December 22, 1911, as already announced in these columns, France has lost a mathematical astronomer of real distinction. Born on January 22, 1835, at Angerburg, in Prussia, he was a student at Konigsberg between 1854 and 1857. The following year he went to Paris, where he became naturalised, and passed the remainder of his life. For many years he acted as secretary to M. Brunetière on the staff of the *Revue des Deux Mondes*. At no time does he seem to have held an official post as a practical astronomer or as a teacher of astronomy. Yet he contributed a very large number of valuable memoirs, for the most part having a direct bearing on theoretical astronomy. Perhaps, as a result of his unofficial position, the greater number of these contributions are not of great length, but in spite of his early training all of them show a freshness of thought and an elegance characteristically French. Among them may be specially mentioned an essay on astronomical refraction, in which the effect of the humidity of the atmosphere is for the first time considered; a very important memoir on the planetary inequalities of the moon, the results of which have been confirmed by Dr. Cowell's analysis of the Greenwich observations (Annals of the Paris Observatory, 1889 and 1893); and memoirs on theoretical dynamics and on interpolation in the Annals of the École Normale and in Liouville's Journal. M. Radau was an editor of the *Bulletin Astronomique* from its inception in 1884, and contributed many elegant notes to its pages. He was also a prolific writer of popular articles, for which he had a marked gift. M. Radau succeeded Tisserand as a member of the Institute in 1897; he was a member of the Bureau des Longitudes, and he was elected an associate of the Royal Astronomical Society so lately as 1905.

DR. SOPHIA JEX-BLAKE, one of the pioneers of the medical education of women, has just died, in her seventy-second year, at her home in Sussex. Dr. Jex-Blake was the youngest daughter of Thomas Jex-Blake, Proctor of Doctors Commons, and was born at Hastings in 1840, where her childhood was passed. As a girl she desired to spend her life in educational work, and at the age of eighteen filled the post of mathematical tutor at Queen's College, London, a post she held for three years. At this time she decided to travel in order to study different methods of education. Whilst in America for this purpose she met Dr. Elizabeth Blackwell, and being impressed with the interest of medicine as a career for women, and the need for medical women to attend those women who desired treatment by one of their own sex, she began to study medicine in Boston, U.S.A. Miss Jex-Blake returned to England in 1868, and finding it impossible to get teaching in London, she and four other women who had joined her went to Edinburgh, where, after some difficulty, certain classes were opened to them for study, but they were debarred from presenting themselves for any qualifying examinations. After much time had been spent and money lost in litigation, though many warm friends had been made, Dr. Jex-Blake came to London, where she soon gathered together a band of sympathisers, among whom were Mr. Garrett Anderson, the late Sir William Broadbent, Prof. Burdon Sanderson, and others, and the London School of Medicine for Women was formed. The school was opened in 1874 with fourteen students, but it was not until 1877 that a qualification could be obtained, when, thanks to the Kings and Queens College of Physicians, now the Royal College of Physicians, Ireland, their examinations were thrown open to women, and qualification and registration were at last able to be obtained. Dr. Jex-Blake subsequently returned to Edinburgh, where she practised for twenty-one years. During that time she opened a dispensary for women and children and a cottage hospital, and in 1886 founded a School of Medicine for Women, which in 1894 was recognised by the University of Edinburgh for the purposes of graduation. For the past twelve years Dr. Jex-Blake lived at her country home in Sussex, where she took great interest in her fruit and flowers. She will always be remembered by those who knew her personally for her charm of voice and her powers of organisation.

DR. W. B. KEMSHEAD, who died at the Charterhouse on January 3, at eighty years of age, was for a number of years science master at Dulwich College. He devoted much of his time to scientific research, and for some years endeavoured to produce a metal which would resist corrosion, for use in the manufacture of miners' lamps.

ON Tuesday next, January 16, Prof. W. Bateson will begin a course of six lectures at the Royal Institution on "The Study of Genetics"; on Thursday, January 18, Prof. A. W. Bickerton will begin a course of two lectures on "The New Astronomy"; and on Saturday, January 20, the Rev. John Roscoe will commence a course of two lectures on "The Banyoro: a Pastoral People of Uganda"—(1) "The Milk Customs"; (2) "Birth and Death Customs." The Friday evening discourse on January 19 will be delivered by Sir James Dewar on "Heat Problems," and on January 26 by Prof. Bertram Hopkinson on "The Pressure of a Blow."

THE following awards of medals and premiums, December, 1911, have been made by the Institution of Mining and Metallurgy, and will be presented at the annual meeting in March:—Gold medal of the institution (two awards): (*a*) to Mr. E. P. Mathewson, Arizona, U.S.A., in recognition of his eminent services in the advancement of metallurgy generally, and especially in regard to copper; (*b*) to Mr. Walter McDermott, in recognition of his special services in the equipment of the Bessemer Laboratory of the Royal School of Mines, and as the representative of the institution on the board of governors of the Imperial College of Science and Technology during the period of its establishment and organisation, and to signalise his services in the advancement of metallurgical practice. "The Consolidated Gold Fields of South Africa, Ltd.," gold medal to Mr. Walford R. Dowling, for his paper on the amalgamation of gold in banket ore. "The Consolidated Gold Fields of South Africa, Ltd.," premium of forty guineas to Mr. A. M. Finlayson, for his paper on secondary enrichment in the copper deposits of Huelva, Spain. "William Frecheville" students' prize of ten guineas to Mr. F. Percy Rolfe, for his paper on shrinkage stoping in Western Australia. "Arthur Claudet" students' prize of ten guineas to Mr. Arthur C. Hoare, for his paper on the roasting of complex ores in gold assaying.

THE seventeenth International Medical Congress is to be held in London from August 6 to August 12, 1913, inclusive. We learn from *The Lancet* that the King has given his patronage, and it is expected that a detailed programme will be issued not later than September 30 next. The officers of the congress are as follows:—*President*, Sir Thomas Barlow, F.R.S.; *vice-presidents*, Sir W. S. Church, Bt., K.C.B., Sir Jonathan Hutchinson, F.R.S., Lord Lister, O.M., F.R.S., Prof. James Little, Sir R. Douglas Powell, Bt., K.C.V.O., Sir Frederick Treves, Bt., G.C.V.O., Sir William Turner, K.C.B., F.R.S., and Sir Hermann Weber; *treasurers*, Sir Dyce Duckworth, Bt., and Mr. G. H. Makins, C.B.; *chairman*

of executive committee, Sir Alfred Pearce Gould, K.C.V.O.; *honorary general secretary*, Dr. W. P. Herringham. The presidents of sections are as follows:—(i) Anatomy and embryology, Prof. Arthur Thomson. (ii) Physiology, Prof. E. A. Schäfer, F.R.S. (iii) General pathology and pathological anatomy, Mr. S. G. Shattock; Subsection, chemical pathology, Dr. F. Gowland Hopkins, F.R.S. (iv) Bacteriology and immunity, Prof. G. Sims Woodhead. (v) Therapeutics (pharmacology, physiotherapy, balneology), Sir Lauder Brunton, Bt., F.R.S. (vi) Medicine, Sir William Osler, Bt., F.R.S. (vii) Surgery, Sir William Watson Cheyne, Bt., C.B., F.R.S.; Subsection A, orthopædics, Mr. Robert Jones; Subsection B, anæsthesia, general and local, Dr. Dudley W. Buxton. (viii) Obstetrics and gynæcology, Sir Francis H. Champneys, Bt. (ix) Ophthalmology, Sir Henry Swanzy. (x) Diseases of children, Dr. Eustace Smith. (xi) Neuropathology, Sir David Ferrier, F.R.S. (xii) Psychiatry, Sir James Crichton-Browne, F.R.S. (xiii) Dermatology and syphilography, Sir Malcolm Morris, K.C.V.O. (xiv) Urology, Prof. E. Hurry Fenwick. (xv) Rhinology and laryngology, Prof. St. Clair Thomson. (xvi) Otology, Mr. Arthur Cheatle. (xvii) Stomatology, Mr. Morton A. Smale. (xviii) Hygiene and preventive medicine, Dr. Arthur Newsholme. (xix) Forensic medicine, Prof. Harvey Littlejohn. (xx) Naval and military medicine, Sir James Porter, Bt., K.C.B. (xxi) Tropical medicine, Sir David Bruce, C.B., F.R.S. (xxii) Radiology, Sir J. Mackenzie Davidson.

To the current issue of *The Popular Science Monthly* Prof. W. E. Ritter, scientific director of the San Diego Marine Biological Station, contributes an article dealing with the duties to the public of research institutes in pure science. He urges that an institution of pure science should be one the primary aim of which is to extend the bounds of man's knowledge of nature in a specified field, and to show something of the significance of the new knowledge for the higher life of mankind. Not only, he insists, must research institutes add to knowledge, but they must show "in language comprehensible to the generally but non-technically educated members of the community something of the meaning of this knowledge for human beings in both the physical and the spiritual aspects of their natures." Prof. Ritter's view is that research institutions, as institutions, ought to hold themselves obliged, from time to time, to give out in a form readily accessible to and comprehensible by the rank and file the results of their most significant achievements. So far as work accomplished in biology is concerned, this popular instruction, it is urged, should be given by professed biologists constantly occupied with the first-hand gathering of data, with the making and testing of hypotheses, and with the submitting of results to fellow-workers for criticism and verification.

In "A First Study of Inheritance in Epilepsy" (Eugenics Record Office, Bulletin No. 4, Cold Spring Harbor, N.Y., November, 1911) Prof. Davenport and Dr. David Weeks discuss an important collection of material bearing on this point. The data consist of the pedigrees of inmates of the New Jersey State Village for Epileptics at Skillman, N.J., obtained at the cost of much care and labour by visiting the homes of the patients and interviewing their parents or other relatives and physicians. The authors conclude that epilepsy and feeble-mindedness behave as Mendelian recessive characters, and state: "it appears, consequently, that when both parents are epileptic, both feeble-minded, or one epileptic and the other feeble-minded, all the offspring will be either epileptic or feeble-minded." We note, however, that in a table facing the page on which this statement is made a mating is recorded in which the two children of a feeble-minded father and an epileptic mother are both normal. Another conclusion is worthy of special reference, namely, that "provided marriage matings continue as at present and no additional restraint is imposed, the proportion of epileptics in New Jersey would double every thirty years."

To the Journal of the Ipswich Field Club for October, 1911, Mr. Alfred Bell contributes an article on the zones of the East Anglian Crags, in the course of which a number of the molluscs are described as new. The Coralline Crag is divided into a Gedgravian and a Boytonian zone, of which the latter forms a transition into the overlying Waltonian of the Red Crag. Lists of the faunas of the Boytonian zone and of the so-called box-stones are given. The author disputes the opinion that the majority of the mammalian remains are older than the Crag itself, but considers that the cetacean remains, more especially those of beaked whales, form an exception in this respect. It is difficult to see the force of this, as all the Crag cetaceans are essentially of a modern type.

When the modern type of shorthorn cattle was produced by careful crossing and selection, no attention was paid to the superficial character of colour, so that in this respect the breed is mongrel, and in consequence it is a general belief that the colour of the progeny of any particular pair cannot be predicted with anything approaching certainty. Consequently, the inheritance of coat-colour among shorthorns forms a problem of great difficulty. It has, however, been taken up by Mr. H. H. Laughlin, of the Carnegie Experimental Evolution Station at Cold Spring Harbour, and the results of his investigations are published in *The American Naturalist* for December, 1911 (vol. xlv., p. 405). These are so complex that it is impossible to give a summary within the limits of our space, although it may be noted that when white shorthorns are crossed with white park-cattle the calves are invariably white. This indicates that the white of park-cattle—although by no means all white—is dominant, park-cattle having, it is believed, formed part of the stock from which the modern shorthorn was evolved.

The extermination of the big-game fauna of German East Africa forms the leading theme in *Naturwissenschaftliche Wochenschrift* for December 17, 1911, Prof. Fritz Behn, who has recently returned from a journey in that province, devoting the whole of a long article to this subject, and Prof. C. G. Schillings supporting his arguments from his own experience. The subject is also touched upon in a third article, by Dr. F. Doflein, on sport and science in the German colonies, where emphasis is laid on the remarkable fact that the prolonged British occupation of India has not resulted in the extermination of a single indigenous species of animal. The rapidity with which the big-game fauna of German East Africa is being wiped out presents a marked contrast to the conditions obtaining in the adjacent British Protectorate, where the establishment of game-reserves, the restrictions in regard to the number of animals shot by sportsmen, and the prohibition of the export of undersized ivory, horns, and skins work wonders. In the German Protectorate the work of destruction is mainly carried on by Boers and professional hunters, and not by the casual sportsman. Unless steps are taken promptly to check the slaughter, there will ere long be no game to protect.

FROM the report of the Department of Agriculture for the Nyasaland Protectorate, it appears that the export of cotton, which in 1903 was valued at only 3*l*., rose in 1909–10 to 26,209*l*., and during the past season to 58,687*l*. The area under crop during the present season is 23,314 acres. This excellent result reflects great credit alike on the planters and on the Agricultural Department; but it is considered not to exhaust the possibilities, but only as an indication of what Nyasaland can do. Selection experiments with Nyasaland upland cotton have been carried out with good results, and some crossing has been done, although this method is now given up. The export of rubber also doubled and is likely to increase considerably in the near future, as the estate rubber is now approaching the age for tapping. Tobacco is proving a useful crop, while maize, coffee, and tea are grown to advantage. The velvet bean (*Mecuna Lyonii*) has been introduced by the department for green manuring purposes.

ALTHOUGH the botany of the Sikkim Himalayas is generally well known, since many botanists have added to the historic explorations of Sir Joseph Hooker, the remote Zemu and Llonakh valleys, in the north-west, are very inaccessible except by an expedition specially arranged at a favourable season, as described by Messrs. W. W. Smith and G. H. Cave, two officials of the Calcutta Botanic Gardens. Their account, published in the Records of the Botanical Survey of India (vol. iv., No. 5), furnishes some indication of the difficulties encountered, including the penetration of the Rhododendron jungle, composed of *R. Whitii*, *R. campanulatum*, and *R. Hodgsoni*, at an elevation of 10,000 feet. The Zemu valley presents a transition from the moist, prolific area in the south to the dry area of Tibetan Sikkim. It resembles the drier aspect of the Llonakh valley, which shows affinities in vegetation with Tibet, in the lack of epiphytic ferns and cryptogams. A survey of the alpine region points to the dominance of the genera Arenaria, Potentilla, Saxifraga, Saussurea, Rhododendron, Primula, and Pedicularis. Under Saxifraga thirty-four species are recognised, including a new crustaceous form resembling a Sedum.

A RECENT number of the *Bollettino* of the Italian Seismological Society contains an account of an interesting meeting of the society held at Rocca di Papa on August 30, 1910, to honour the memory of the late Prof. M. S. de Rossi, the pioneer of seismological studies in Italy. The memorial consists of a stone placed in the front of the Observatory of Rocca di Papa stating that in this his house Michele Stefano de Rossi first in Italy made systematic observations on terrestrial dynamism and published very valuable statistical data. The observations were carried on from 1874 until de Rossi's death in 1898, and are recorded in his well-known works the "Meteorologia Endogena" and the seventeen volumes of the *Bollettino del Vulcanismo Italiano*.

THE history of the numerous attempts that have been made to predict the occurrence of earthquakes is summarised in an interesting paper by Mr. G. Martinelli (*Boll. Sismol. Soc. Ital.*, vol. xv., 1911, pp. 154–90). An account is given of many phenomena which were generally supposed to precede earthquakes, such as various states of the weather, the physiological condition of observers, the position of the greater planets, and the occurrence of microseismic storms. Although we are still very far from the solution of the problem, Mr. Martinelli indicates two lines of research which may ultimately lead us in the right direction—the study of electromagnetic phenomena and of the gradual deformation of the earth's crust. Of the two methods, he considers, and no doubt rightly, that the latter is the more promising, for it is connected with the movements which are now known to be the chief cause of earthquakes.

WE have received copies of the tide tables for the eastern coasts and for the Pacific Coast of Canada for the year 1912, which are published by the Tidal and Current Survey of the Dominion of Canada. Longer series of observations are available for the eastern coast, but it is estimated that for at least three ports on the Pacific Coast—Sand Heads, Vancouver, and Port Simpson—the tables are now superior to those for any other port on the Pacific coasts.

A SCIENTIFIC expedition left Trieste at the end of October, 1911, under Dr. L. Brühl, of the Institut fur Meereskunde of Berlin, for the Dead Sea and the Jordan Valley, in order to study the chemical, physical, and biological problems which this region presents, so as to extend and complete the earlier work in these directions which was done by the expeditions of Lynch in 1848 and of the Duc de Luynes in 1864. According to *Petermann's Mitteilungen*, the expedition will probably return about the end of January.

IN the October (1911) number of *La Géographie* Dr. H. Hubert discusses the thunderstorms which occur so frequently in the southern portions of the western Sudan, and furnish the larger part of its annual rainfall. He recognises two principal directions of air currents: one from the north-east, which blows persistently during the dry season, and even during the summer rainy season still prevails at an altitude of about 2000 metres; and another, the south-westerly monsoon current, which blows as a light, moist surface wind, ranging up to about 1000 metres in the summer months. A few observations are quoted to indicate the directions of the upper and lower air currents during the passage of a thunderstorm, and the general direction of their movement is given as being from east-south-east to west-north-west, with a velocity of translation of about 60 kilometres per hour. Rain due to such thunderstorms will be recorded by travellers as coming from the east, though the ordinary rains of the wet season accompany the southerly and south-westerly current of the monsoon.

WE have recently received from the Australian Central Weather Bureau a report by Mr. F. A. Hunt of his visit to Europe, Asia, and North America, undertaken by direction of the Commonwealth Government for the purpose of "discussing with other meteorologists the most modern methods of organisation and equipment." Mr. Hunt left Australia in July, 1908, and returned in March, 1909; and although three years have elapsed since some of the places were visited, and changes (especially in this country) have taken place, the reports of the various services contain much useful information and are convenient for reference. Those relating to Canada and India are very full. We are glad to see that the various proposals made by Mr. Hunt and by the Melbourne conference (held in May, 1907) have been generally approved by the Commonwealth Department for Home Affairs.

THE meteorological charts issued for the various oceans by the Weather Services of the United States, Germany, and this country for December, 1911, include interesting and useful data. The U.S. Bureau has issued separately a useful "Marine Calendar" summarising the monthly weather conditions in the North and South Atlantic Oceans. The interesting synoptic charts showing the weather in the North Atlantic for December 7–13, 1911,

prepared by the Meteorological Office, explain the very unsettled weather over this country and western Europe. While on the American side of the Atlantic the distribution of pressure was anticyclonic, and the weather for the most part fair and quiet, the weather over the eastern half of the ocean remained in an exceedingly disturbed state. A summary given of the Arctic weather in the summer of 1911 from the log of the whaler *Diana* is of interest. The ship passed Cape Wrath outwards on April 24, and again homewards on November 1; she reached lat. 75° 28′, long. 75° 19′ W., on July 18. Fog was included in 25 per cent., and snow in about 20 per cent., of the weather observations. The lowest temperature recorded was 23°, on May 22. Gales were experienced in each month, especially in May and October. The north-west storm of October 30, in about 59° N., 10° W., was little short of a West India hurricane.

According to the December (1911) number of *The Illuminating Engineer* of New York, the American illuminating engineer, after devoting his attention in the past mainly to mechanical efficiency, is now in a position to consider looks, and the question of attractive design will play a prominent part in his business in the near future. He appears to feel acutely the monopoly in electric lamps held by the National Electric Lamp Co. The relations between the gas and electric companies seem to be as strained in America as they are in this country. At the recent annual Convention of the National Commercial Gas Association there were papers read which, on the one hand, treated gas lighting as a decaying industry, and on the other claimed for it a position of recognised superiority. With such extreme statements possible, it does not appear that the question is any nearer settlement in America than it is here. The present tendency to use as the source of light a tungsten filament or an incandescent mantle, neither of which can with comfort be viewed directly, and to place them in situations in which they are not themselves visible, may lead to more trustworthy statements as to their relative merits.

In the Proceedings of the Royal Academy of Sciences of Amsterdam (November 22, 1911, p. 370) Dr. Th. Weevers describes the isolation from the spadix of *Sauromatum venosum*, Schott., by pressing out and precipitating the press-juice with alcohol or acetone, an enzyme which decomposes dextrose with formation of carbonic and organic acids, but without any production of alcohol. The decomposition occurs equally well in an atmosphere of either air or hydrogen. The action of the enzyme is in some respects, especially as regards the formation of acids, reminiscent of that of certain fungi and of the nocturnal production of acids by Crassulaceæ. The acid formed is non-volatile with steam, and is therefore not formic, acetic, propionic, or a higher fatty acid; judging by microchemical tests, citric acid is formed, and in one instance malic acid was detected. Other acids may perhaps be present, but lactic and tartaric acids are apparently not formed. The same enzyme, but weaker in action, was isolated from the leaves of the same plant. It is noteworthy that, contrary to what appears to be the case with other respiratory enzymes, alcohol and acetone do not destroy its action, so that there is little, if any, loss of activity on precipitation of the aqueous extracts with these solvents.

The Scientific American for December 9, 1911, is a special naval number containing many articles by chief officials connected with the United States Navy. Dealing with the question of ammunition, we note that Rear-Admiral N. C. Twining, Chief of the Bureau of Ordnance, states that nitro-cellulose smokeless powder continues to be the standard propellant. He claims for this powder that it is extremely satisfactory in stability, ballistic characteristics, and keeping qualities, and that there is no better smokeless powder in the world. The powder consists essentially of cotton dissolved in nitric acid, then dried, colloided, and pressed into the desired form of grain. When not unfavourably affected by climatic and other adverse conditions, the powders retain their qualities for from twelve to fifteen years. In case deterioration occurs, due to such conditions, ample warning is given by the physical appearance of the powder, so that no spontaneous explosion or combustion is ever to be apprehended; it is, in fact, extremely doubtful whether spontaneous combustion is possible, unless the powder should be subjected to abnormally high temperatures. Powder which has changed in character to such an extent as to reduce its ballistic value is now reworked and made over into new powder.

Dealing with failure of buildings caused by the drought of last summer, an article in *The Builder* for January 5 says that it is impossible to estimate the enormous damage to buildings throughout the country produced by such weather conditions as have been experienced. Suburban London has suffered to a remarkable degree. In many districts where the foundations rest upon clay buildings by the hundred have needed underpinning. Clay retains a considerable amount of water in its structure, and even at the height of an ordinary summer is found to be quite moist at a depth of from 2·5 to 3 feet from the surface. Last year, however, the moisture evaporated to a much greater depth, and the clay was often found to be perfectly dry at depths of 5 and 6 feet. The consequent shrinkage in bulk led to settlements in the buildings above. Again, clay when dry tends to fall to powder, and the early autumn rain, instead of percolating gradually through the soil, finds its way into the fissures and washes the powdered clay out of its place. Sliding or lateral movement is likely to occur where a part only of the soil is wet, the remaining parts being still quite dry. The stability of a structure depends not so much upon whether the clay is moist or dry as upon the condition, whichever it be, remaining unaltered. The consideration of the action of the weather upon the clay emphasises the importance of obtaining a depth of foundation sufficient to reach below the point affected by sun and rain, and, further, of carrying all foundations to a uniform depth. The writer of the article, in dealing with more than seventy cases of failure last autumn, found only two or three cases of fractures occurring where the foundations were at a uniform depth. The explanation is that uniform depth of foundation is more likely to secure even settlement of the structure.

The presidential address to the Dumfriesshire and Galloway Natural History and Antiquarian Society, delivered by Mr. Hugh S. Gladstone on October 20 last, consisted of addenda and corrigenda to his volume "The Birds of Dumfriesshire," which was reviewed in these columns on January 19 of last year (vol. lxxxv., p. 378). The council of the Dumfries society has published the address in pamphlet form, and this will prove a valuable adjunct to Mr. Gladstone's book.

Messrs. J. and A. Churchill announce the following works for early publication:—"Diseases of the Stomach," by Prof. C. D. Aaron; "Who's Who in Science, 1912," edited by H. H. Stephenson; "Annual Tables of Constants and Numerical Data," issued under the authority of the International Congress of Applied Chemistry. The tables are intended to contain all the numerical data likely to be of interest in connection with chemistry, physics, and allied sciences, pure and applied, to be found in the literature published during the previous year.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF COMETS 1911*c*, 1911*e*, 1911*f*, AND 1911*g*.—In No. 4544 of the *Astronomische Nachrichten* Dr. Bemporad discusses at length the photometric observations of Brooks's comet (1911*c*), made at the Catania Observatory during the period August 14 to November 28, 1911. The greatest apparent brightness was recorded on October 23, when the comet was about as bright as a 3·5 magnitude star. On a chart accompanying the paper he plots the curves $i = k/r^2\Delta^2$ and $i = k/r^4\Delta^2$ with the curve of observed magnitudes, and this shows that the comet became brighter even than the value given by the latter formula. A fourth curve, on which the intensities reduced to $\Delta = 1$ are shown, indicates that the rise of intensity near perihelion was very steep, the magnitude rising from 9·5 on October 12 to 4·8 at perihelion.

As an abstract from *Hemel en Dampkring* (October, 1911), Prof. Nijland sends us an account of the Utrecht observations of comets 1911*c*, 1911*f*, and 1911*g*. A drawing of Beljawsky's comet (1911*g*), made on October 1, 1911, shows the head quite near to ι Leonis, with the tail extending nearly to η Leonis, while an enlarged drawing of the head shows two dense streamers flowing as a parabolic envelope from the head.

The Algiers observations, made by MM. Rambaud and Villatte, of Borrelly's comet (1911*e*) are reported in No. 4544 of the *Astronomische Nachrichten*. On October 27, 1911, the comet was observed as a round nebulosity 45″ in diameter, with a brilliant nucleus of magnitude 10·5.

A BRILLIANT METEOR.—A meteor of extraordinary brilliancy was observed at South Kensington by Mr. W. Moss at 5h. 10m. on December 22, 1911. Starting from a point near ε Persei, the object moved very quickly, passing above Mars and Saturn to a point $\alpha = 35°$, $\delta = +12°$. The latter part of the path was distinctly wavy, and the meteor was at least as bright as Mars, and left a slight trail.

NICKEL-ON-GLASS REFLECTORS.—As is well known to anyone who has done any photographic work in the ultra-violet, silver reflects scarcely any light in the neighbourhood of λ 3160, therefore, for this special region, a silver-on-glass mirror is practically useless as a reflector. To overcome this difficulty, primarily in his experiments on the ultra-violet photography of the moon, Prof. R. W. Wood carried out some trials, during his last summer vacation, in which he endeavoured to replace the silver film on a figured glass disc by some other metal capable of reflecting light throughout the whole range of the spectrum; the production of large mirrors of speculum is too difficult for ordinary work.

Consulting Rubens's tables, he found that nickel was probably the most suitable metal, and after numerous experiments he succeeded in depositing, electrolytically, a film of nickel on a previously silvered, figured disc. The method of doing this and the results obtained are described in an interesting paper which Prof. Wood publishes in No. 5, vol. xxxiv., of *The Astrophysical Journal*. To illustrate the various reflecting powers of glass, silver, nickel, and speculum, he photographed, through a quartz lens, a mirror partly covered by Ag, partly by Ni, and partly left bare, alongside a piece of polished speculum. With blue and violet rays passing through the lens the order (increasing) of reflecting power was glass, Ni, Ag, speculum, but when the quartz lens was heavily coated with silver, thus allowing only the ultra-violet rays to pass through it, the silver was found to reflect as little as the bare glass, and came out nearly black, while the nickel surface was almost as bright as the speculum surface on the resulting photograph. Incidentally, Prof. Wood points out that such ultra-violet photography as that which he has applied to the moon may prove exceedingly useful in other branches of science. For example, some white substances come out quite black (*e.g.* zinc oxide), and white flowers show very different reflecting powers; common phlox comes out quite black, while white geraniums are much lighter.

ALMANACS FOR 1912.—From the Observatory of Madrid we have received a copy of the official *Anuario* (525 pages) for 1912, which, in addition to the usual astronomical and meteorological tables, contains special articles dealing with the observations of comets, the solar eclipse of April 17, the spectroheliograph of the Madrid Observatory, and the solar and meteorological observations made in 1910. From the discussion of the various data, the writer of the article on the April eclipse suggests that possibly a totality of three or four seconds will occur in Spain and Portugal, and mentions three favourable stations, viz. Cacabelos, Barco de Valdeorras, and Verin.

The *Annuaire Astronomique* for 1912, published by M. Flammarion, is of the usual form, and, being published later than usual (December, 1911), contains in the annual *revue* of astronomy some very interesting notes and comments on recent solar, planetary, and cometary observations.

The "Companion to the Observatory" is too well known to need any description here, and should, of course, be in the observatory of every British astronomer. This year's issue resembles that of other years, and may be obtained from Messrs. Taylor and Francis at the price of 1*s*. 6*d*.

THE PALISA-WOLF STAR CHARTS.—The fifth series of the star charts prepared by Drs. Palisa and Wolf is now ready, and until April 1 a set may be obtained for 30 marks; after that date the price will be 40 marks.

WEATHER IN 1911.

FROM a meteorological point of view, the year which has just closed was of considerable interest. The feature which stands out beyond all others is the abnormal summer, during which both the temperature and sunshine have established a record, whilst the rainfall was also exceptional. After the heat and brilliancy of the summer, the exceptionally heavy rains of the late autumn and early winter are probably of next importance, although in many parts of England rain was sorely needed.

Taking the country as a whole, the mean temperature for the year was everywhere in excess of the average, and in England, where the excess was greatest, the difference amounted to fully 2°. The rainfall was deficient over the entire kingdom, except in the south-east of England and the Channel Islands, the deficiency in the English Midlands, where the summer drought was keenly felt, amounting to 4·20 inches, the aggregate rainfall being only 84 per cent. of the average. The duration of bright sunshine was everywhere largely in excess of the average, the excess amounting to 336 hours in the south-east of England, and the duration was 121 per cent. of the normal.

The Greenwich observations, which may fairly be taken to represent England, show that the mean temperature for the year was 52°, which is 2° above the average. The warmest month was August, with the mean temperature 69°, which is 6° above the average, and was the warmest August since 1841. The temperature was in excess of the average every day throughout the month, and on August 9 the sheltered thermometer registered 100°, which is the highest reading as yet recorded in any part of the British Isles. The mean temperature in July was 68°, which is 4·5° above the average, and there have only been two Julys warmer in the last seventy years. The first twelve days of September were also the warmest on record. The mean temperature was in excess of the average in every month, with the exception of January and April. The thermometer was continuously above the average for sixty days from July 11 to September 13, and there were in all 224 warm days during the year. The lowest temperature was 22°, in February, and frost occurred on thirty-three days. Two of the coldest days on record for April occurred on April 5 and 6, and on May 22 the radiation temperature fell to 25°.

The aggregate rainfall for the year was 23·67 inches, which is 0·46 inch less than the average. The rainfall was above the normal in six months and below in six months. The wettest month was December, with 3·99 inches, which is 2·16 inches more than the average, and in both October and November the rainfall exceeded 3 inches. The total for the three closing months of the year was 10·71 inches, which is 45 per cent. of the fall for the year. The driest month was July, when the total measurement was 0·26 inch, and rain only fell on three days during the month. The aggregate summer rainfall, for June, July, and

August, was 3·72 inches, which has only been smaller in three previous summers since 1841. There were during the summer two periods of absolute drought—twenty-three days from July 1 to 23, and seventeen days from August 2 to 18. Rain fell on 156 days during the year; December had twenty-three wet days and November twenty.

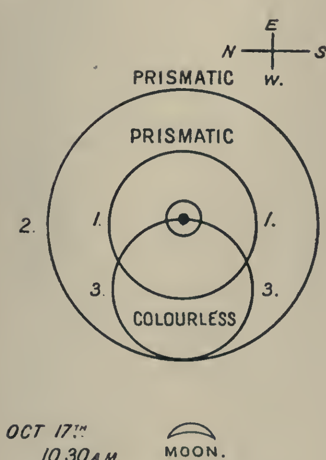
In the Ebbw Vale Sir Alexander Binnie measured 29·23 inches of rain from October 18 to December 31, and during the whole of this period there were only nine days without rain.

The duration of bright sunshine at Greenwich was 1780 hours, which is 425 hours in excess of the average of the past thirty years, and is the brightest year on record since 1881; the next brightest year was 1906, with 1735 hours. July had 335 hours' sunshine, which is the sunniest month since the establishment of sunshine records in 1881. The duration of sunshine was in excess of the average in each month, with the exception of January and March.

CHARLES HARDING.

OBSERVATION OF SOLAR HALOS IN AFRICA.

An optical phenomenon is reported by a correspondent from Elobey Island, lat. 1° N., long. 9° 30′ E., in the Gulf of Guinea. On October 11, 1911, between 1 and 2 p.m., he observed "a large light, of different colours as the rainbow, encircling the sun, and at times only visible on the east side and sometimes only on the west of the sun, and at 2 p.m., our time, disappeared altogether." During this time the sky was covered with swiftly passing small clouds, and shortly after the disappearance of the phenomenon heavy rains began to fall. Without information as to the angular diameter of the ring or the order of the colours it is not possible to say with certainty whether it was a halo or a corona, but its appearance with low clouds makes it probable that the phenomenon was a corona. The corona sometimes appears round the sun when it shines through thin cloud or mist. It is coloured, red being outermost, and several successive sets of coloured rings are usually formed. They are due to the diffraction which the light undergoes in passing among drops of which the cloud is composed. The radius of the first ring of the corona varies from 1° to 3°, according to the size of the drops, and radii of the others are successive multiples of that of the first. As the drops of water in the mist or cloud become larger the rings grow smaller. Their diminution consequently implies approaching rain.



Six days after the observation at Elobey Island, on October 17, the combination of halos shown in the diagram was observed by Mr. J. G. Orchardson at Kericho, in British East Africa. The halos 1 and 2 are probably the two of most common occurrence, with radii of about 22° and 46° respectively. The altitude of the sun at the time of the occurrence was presumably about 65°–70°, and for this altitude the horizontal circle through the sun, on which mock suns are usually found, would just touch the larger halo and appear to have its centre on the smaller halo. This ring would be produced by reflection at the vertical faces of ice crystals in the higher atmosphere. It seems most likely that this is the origin of ring No. 3. If, however, the circle had been parallel with the horizon, it is probable that the fact would have been mentioned by the observer. The other possibility is that the circle was a secondary halo formed about a mock sun in the same way as the 22° halo is formed about the sun itself. Such secondary haloes are very rare. The position of the mock sun which could produce one in the present case would be at the point where the vertical through the sun met the halo of 22° either at the zenith or half way between the horizon and the zenith. In the former case the secondary halo and the mock sun ring would coincide.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1913.

Geometry.—The Francœur prize (1000 francs), for discoveries or works useful to the progress of pure or applied mathematics; the Bordin prize (3000 francs), for improving in some important point the arithmetical theory of non-quadratic forms.

Mechanics.—A Montyon prize (700 francs), for inventing or improving instruments useful in agriculture or the mechanical arts or sciences; the Poncelet prize (2000 francs), for a work on applied mathematics.

Navigation.—The extraordinary prize of 6000 francs, for a work increasing the efficiency of the French Navy; the Plumey prize (4000 francs), for improvements in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—The Pierre Guzman prize (100,000 francs), for the discovery of a means of communicating with a star other than the planet Mars; the Lalande prize (540 francs), for the most interesting observation, memoir, or work contributing to the progress of astronomy; the Valz prize (460 francs), for the most interesting astronomical observation made during the year; the G. de Pontécoulant prize (700 francs).

Geography.—The Tchihatchef prize (3000 francs), for the encouragement of explorers of the lesser known parts of Asia; the Gay prize (1500 francs), for a study of the reptiles of warm countries, especially the reptiles of Mexico.

Physics.—The Hébert prize (1000 francs), for the best treatise or most useful discovery for the practical application of electricity; the Hughes prize (2500 francs), for discoveries or works contributing to the progress of physics; the Gaston Planté prize (3000 francs), for an important discovery or invention in the field of electricity; the Kastner-Boursault prize (2000 francs), to the author of the best work on the various applications of electricity in the arts, industry, and commerce.

Chemistry.—The Jecker prize (10,000 francs), for works contributing to the progress of organic chemistry; the Cahours prize (3000 francs), for interesting researches in chemistry; a Montyon prize (unhealthy trades; a prize of 2500 francs and a mention of 1500 francs), for the discovery of a means of ameliorating an unhealthy trade or occupation; the Vaillant prize (4000 francs), for the discovery of a photographic layer without visible grain and as sensitive as the gelatino-bromide now used.

Mineralogy and Geology.—The Victor Raulin prize (1500 francs), for assisting the publication of works relating to geology and palæontology; the Delesse prize (1400 francs), to the author, French or foreign, of a work on geological or mineralogical science; the Joseph Labbé prize (1000 francs), for geological works or researches putting in evidence the mineral riches of France, its colonies or protectorates.

Botany.—The Desmazières prize (1600 francs), for the best work published during the year on Cryptogams; the Montagne prize (1500 francs), for works on the anatomy, physiology, development, and description of the lower Cryptogams; the de Coincy prize (900 francs), for a work on Phanerogams; the grand prize of the physical sciences (3000 francs), for the geographical study of the flora of French western Africa; the Thore prize (200 francs), for the best work on the cellular Cryptogams of Europe; the de la Fons-Mélicocq prize (900 francs), for the best work on the botany of the north of France.

Rural Economy.—The Bigot de Morogues prize (1700 francs), for a work contributing to the progress of agriculture in France.

Anatomy and Zoology.—The Savigny prize (1500 francs), for the assistance of young travelling naturalists, not receiving Government assistance, who specially work on the invertebrates of Egypt and Syria; the Cuvier prize

(1500 francs), for a work on zoological palæontology, comparative anatomy, or zoology.

Medicine and Surgery.—Montyon prizes (prize of 2500 francs, mentions of 1500 francs), for work contributing to the progress of medicine; the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, pharmaceutical science, or in botany in its relation to medicine; the Breant prize (100,000 francs), for a discovery eradicating Asiatic cholera; the Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the urino-genitury organs; the Baron Larrey prize (750 francs), to a physician or surgeon belonging to the Army or Navy for a work treating a subject of military medicine, surgery, or hygiene; the Bellion prize (1400 francs), for valuable discoveries in medicine or hygiene; the Mège prize (10,000 francs), to an author who will continue and complete the founder's essay on the causes which have retarded or favoured the progress of medicine; the Argut prize (1200 francs), for a discovery of a cure for a disease at present incapable of treatment by surgery.

Physiology.—A Montyon prize (750 francs), for work in experimental physiology; the Philipeaux prize (900 francs), as a recompense for researches in experimental physiology; the Lallemand prize (1800 francs), for works relating to the nervous system; the Pourat prize (1000 francs), for researches on the actions exerted by the X-rays and radium rays upon the development and nutrition of living cells.

Statistics.—A Montyon prize (one prize of 1000 francs and two mentions of 500 francs).

History of Science.—The Binoux prize (2000 francs).

General Prizes.—The Arago, Lavoisier, and Berthelot medals; the Henri Becquerel prize (3000 francs); the Gegner prize (3800 francs), for researches or work contributing to the progress of science; the Lannelongue prize (2000 francs), for the assistance of scientific workers or their relations in distress; the Gustave Roux prize (1000 francs); the Trémont prize (1100 francs); the Wilde prize (one of 4000 francs and two of 2000 francs), for discoveries in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Lonchampt prize (4000 francs), for a memoir on the diseases of man, animals, or plants from the special point of view of the introduction of mineral substances in excess as the cause of these diseases; the Saintour prize (3000 francs), for work in mathematics; the Fanny Emden prize (3000 francs), for a work treating of hypnotism, suggestion, or physiological actions exerted at a distance on the animal organism; the Petit d'Ormoy prize (two prizes of 10,000 francs), for work in pure or applied mathematics or natural science; the Pierson-Perrin prize (5000 francs), for an important discovery in mechanics or physics; the Parkin prize (3400 francs), for work on the therapeutic effects of carbon dioxide or on the effects of volcanic action in the production of epidemic diseases; the Estrade-Delcros prize (8000 francs); the Danton prize (1500 francs), for researches relating to radiant phenomena; the prize founded by Mme. la Marquise de Laplace; the Félix Rivot prize (2500 francs).

FORESTRY IN NORWAY.

THE progress of scientific forestry in Norway forms the subject of an interesting article, by Mr. S. Burtt Meyer, in No. 5 of the Journal of the Board of Agriculture. No less than 21·4 per cent. of the total area of Norway is under forest, as against 3·9 per cent. in the United Kingdom. The most abundant forest tree is the Scots pine (*Pinus Sylvestris*), followed by the birch and the spruce (*P. excelsa*). The alder, aspen, and rowan are distributed pretty generally, while the oak, ash, elm, and beech are also found in favoured areas. The commercial timbers, however, are the Scots pine and the spruce, the latter being of great importance since the introduction of the wood-pulp trade. Spruce forms much the best material for wood pulp. A certain amount of pine can be added, but more than about 15 per cent. tends to spoil the colour. Spruce grows at a lower altitude than pine, and, generally speaking, in a more southern latitude. South of Trondhjem the pine usually ceases at about 2600 feet above sea-level, where it is replaced by the birch; above 3500 feet only dwarf birch and willow occur, while at some 4000 feet the snow-line stops all vegetation. The best forest land is that lying in the neighbourhood of Christiania extending north and north-east over the Glommen watershed. The management of the forest is on the whole good, and well adapted to the local conditions. The work of felling and removing the timber commences in autumn and continues throughout the winter, being greatly facilitated by the snow which covers the ground from November until March or April.

One common system consists in clearing a circle until its diameter equals the height of the surrounding trees. Labour is obtained largely from the small peasant proprietors, who preponderate so largely in the country. Much attention is devoted to afforestation, two societies, the Royal Society for the Welfare of Norway, and the Norwegian Forestry Society, interesting themselves considerably in this question. Afforestation has naturally received most attention in the coast provinces, but preparatory schemes for land drainage and improvement have also been made for districts in the interior, while planting has been widely carried on over the high-lying Crown lands of eastern Norway. On account of the snowfall, planting is only possible in early summer or early autumn.

Shifting sands on the coast are planted up in the same manner as on the northern shores of Jylland, in Denmark. Irregularities in the surface are filled in, the ground is then covered with moss, heather, or any kind of loose material, pegged down when necessary, seed of Elymus or *Arundo arenaria* is sown, and lastly broad strips are planted with *Pinus maritima*.

THE DEVELOPMENT OF CRYSTAL FACES.

IN a memoir by M. P. Gaubert entitled "Recherches récentes sur le Facies des Cristaux," published by the Société de Chimie physique, some remarkable new facts are described regarding the influence of foreign substances on the development of crystal faces. The most interesting relate to the influence of colouring matters, such as methylene blue, eosine, fuchsine, and picric acid, which are shown to be capable of passing into the crystal substance in two different ways. According to one, the colouring matter is deposited on the crystal in the course of growth; this occurs when the solution is saturated with the colouring matter, which thus deposit crystals. An excellent example is afforded by lead nitrate, which when pure usually deposits colourless octahedral crystals. When the mother liquor is saturated with methylene blue, the crystals first deposited exhibit cube faces modifying those of the octahedra, and these cube faces alone are coloured blue; they also exhibit striations like pyrites, corresponding to the faces of the pentagonal dodecahedron. The colour thus not only attaches itself to the faces of a particular form, but indicates the true class of symmetry of the system, in this case a class lower than the holohedral. Similar phenomena are described with gypsum, copper sulphate, thallium sulphate, and morphine, all of which develop specific unusual forms and faces, coloured by the dye, when the latter is methylene blue. Strong polychroism is also introduced in the case of copper sulphate.

The second mode of coloration occurs when a dye stains the crystals grown whatever be the state of dilution of the dye. Nitrate of urea is a good example. The ordinary crystals are monoclinic tables parallel to the basal plane {001}, bounded by the prism {110} and pinakoids {100} and {010}. But when methylene blue is present the two latter forms are suppressed, and the plates are coloured blue and elongated along the axis of the prism {110}. If, however, picric acid be used as the colouring matter, the facial disposition is entirely altered, the pinakoids being developed, but not the prism. More remarkable still, when both methylene blue and picric acid are present, the crystals of urea nitrate show all four forms, and the plate shows eight sectors, four coloured blue, corresponding to the prism faces, and four yellow opposite the pinakoid faces. Phthalic acid exhibits analogous phenomena with methylene blue, malachite green, and scarlet of Biebrich, specific forms staining with each dye, and the crystal showing differently coloured sectors when the dyes are simultaneously present. The reasons for these remarkable phenomena are not convincingly brought out in the memoir, and it is obvious that an interesting new field of work is opened up, in which much will have to be done before the solution of the problem is satisfactorily achieved.

MAYER'S PAPERS ON THE CONSERVATION OF ENERGY.

THE recent issue as one of the volumes of Ostwald's "Klassiker der exakten Wissenschaften" of Robert Mayer's two papers of 1842 and 1845, on the subject now known as the conservation of energy, will prove a great boon to those interested in the early history of that great generalisation. Traces of the idea may be found amongst the ancients, and Descartes held that it was a self-evident truth. But in the middle of the seventeenth century the term energy had but a vague significance, even in the simple case of a moving body, and the doctrine of conservation, when held, meant little or nothing for physical science. Towards the middle of the nineteenth century interest in the question appears to have been widespread. Séguin in France in 1839 calculated the mechanical equivalent of heat from the fall of temperature of steam when expanding against external pressure; Joule in England in 1840 showed that when a battery of cells drives a motor the consumption of zinc in the cells is proportional to the work done by the motor; and Mayer in Germany, after explaining how the term energy was to be understood, stated the generality of the law in his first paper in 1842, and with greater clearness in his pamphlet of 1845.

The titles of Mayer's publications were not such as to suggest the subjects treated in them, and they were so little known, even in Germany, that Helmholtz in 1847 published his paper on the subject without any reference to Mayer. In the meantime, Colding in Denmark had read a paper to the Royal Society of Copenhagen in 1843 in which he stated clearly the law of conservation of energy, and Joule read before the British Association in the same year the first of his papers on the measurement of the mechanical equivalent of heat. Before the middle of the century Joule's experimental work had placed thermodynamics on a firm basis. When the contributions of Séguin and of Colding, and possibly of others whose work has been overlooked, are republished in a form as accessible as are those of Mayer, Joule, and Helmholtz, it may be possible to apportion the credit for one of the greatest generalisations of the nineteenth century in a way to satisfy even the most captious critic.

NATURAL SELECTION IN MAN.

MR. E. C. SNOW, in his paper entitled "The Intensity of Natural Selection in Man" (Drapers' Company Research Memoirs, Studies in National Deterioration, No. vii. London: Dulau and Co., 1911), has set himself to answer the following question: Has heavy infantile mortality any selective value or tendency to eliminate the more sickly and to spare the hardier children? Of the data available for the investigation of this problem, the most satisfactory are derived from the annual volumes of Prussian statistics, and the most definite of the results were obtained from them. In order to indicate the method employed, one example will be described. Thirty rural districts in Prussia were taken, and all the children in them born in the year 1881 were considered. It was ascertained for each district how many of these children died in the first two years of life and how many in the next eight. Now it is obvious that if the infantile mortality tends to weed out the weaker children, then in those districts in which the mortality among the children born in 1881 was highest in the years 1881 and 1882 it should tend to be lowest in the years 1883–90, since stronger children less likely to succumb to the ailments of childhood would have survived their first two years. In other words, there will be a *negative* correlation between the number of deaths in the first two years of life and the number in the next eight, provided that allowance is made for the total number of births in each district for the year 1881 and for the effects of environment. After making these necessary allowances by means of the formula for partial correlation, a coefficient of −0·93 was obtained in the case of males and of −0·85 in the case of females.

These results, considered by themselves, would seem to show that the selective action of infantile mortality was very strongly marked; but it is perhaps unnecessary to say that the author, whose work bears every sign of the most painstaking care and thoroughness, has brought forward a considerable body of additional evidence derived from data of a similar nature collected both in England and Germany. The greater part of it corroborates the conclusion stated above, though the correlation coefficients were in no other cases found to be so high, and in some cases the sign was actually positive. Yet we are of opinion that, on the whole, the author is justified in saying: "Natural selection in the form of a selective death-rate is strongly operative in man in the earlier years of life." A word of praise must be added on the composition of the memoir: it is fair, clear, and interesting.

E. H. J. S.

THE KING ON EDUCATION IN INDIA.

DURING his visit to Calcutta the King-Emperor and Queen-Empress received in the Throne Room an address from the University of Calcutta. The address was read by the Vice-Chancellor of the University, Sir Asutosh Mukharji, and Lord Hardinge, the Governor-General, was present in his capacity of Chancellor of the University. In his reply to the address the King-Emperor said:—

"I recall with pleasure the occasion on which, six years ago, I received from the University of Calcutta the honorary degree of a Doctor of Law, and I am glad to have an opportunity to-day of showing my deep and earnest interest in the higher education of India. It is to the universities of India that I look to assist in that gradual union and fusion of the culture and aspiration of Europeans and Indians on which the future well-being of India so greatly depends. I have watched with sympathy the measures that from time to time have been taken by the universities of India to extend the scope and raise the standards of instruction. Much remains to be done. No university is nowadays complete unless it is equipped with teaching faculties in all the more important branches of the sciences and the arts, and unless it provides ample opportunities for research. You have to conserve the ancient learning and simultaneously to push forward Western science. You have also to build up character, without which learning is of little value. You say that you recognise your great responsibilities. I bid you God-speed in the work that is before you. Let your ideals be high and your efforts to pursue them unceasing, and, under Providence, you will succeed.

"Six years ago I sent from England to India a message of sympathy. To-day in India I give to India the watchword of hope. On every side I trace the signs and stirrings of new life Education has given you hope; and through better and higher education you will build up higher and better hopes. The announcement was made at Delhi by my command that my Governor-General in Council will allot large sums for the expansion and improvement of education in India. It is my wish that there may be spread over the land a network of schools and colleges, from which will go forth loyal and manly and useful citizens, able to hold their own in industries and agriculture and all the vocations in life. And it is my wish, too, that the homes of my Indian subjects may be brightened and their labour sweetened by the spread of knowledge with all that follows in its train, a higher level of thought, of comfort, and of health. It is through education that my wish will be fulfilled, and the cause of education in India will ever be very close to my heart.

"It is gratifying to me to be assured of your devotion to myself and to my house, of your desire to strengthen the bonds of union between Great Britain and India, and of your appreciation of the advantages which you enjoy under British rule. I thank you for your loyal and dutiful address."

Since the new University Act was passed in 1904, considerable and satisfactory progress has been made in India in all branches of education, and the university standards, in particular, have been raised and made more real and effective. There are many signs of educational activity in India, and if the true purpose of education be kept well in mind the country will enter upon an era of increased prosperity based upon increase of knowledge.

RECENT PROGRESS IN SPECTROSCOPIC METHODS.[1]

AN observer who for the first time views the light of the sun through a prism cannot fail to express his wonder and delight at the gorgeous display of colours into which the white light is separated; and if the observation is made under the same conditions as in the celebrated experiment of Newton, 1666, there is, in truth, nothing else which he could observe. You will remember that he allowed a beam of sunlight to stream through a round opening in a shutter of his window, falling on a glass prism, which bent the sun-rays by different amounts depending on their colour, thus spreading out the white round sunlit spot on the opposite wall into a coloured band—the spectrum—which he rather arbitrarily divided into seven colours—red, orange, yellow, green, blue, indigo, and violet. (If the division were made to-day I doubt if indigo would be included.) There is, in fact, no definite demarcation between these, and they shade insensibly into each other, and if the solar spectrum were always produced under these conditions we should say it was continuous; indeed, if it were not the sun, but an argand burner or an incandescent lamp, which served as source, it would really be so.

But even if the source consisted of isolated (but sufficiently numerous) separate colours, the fact would be disguised by the overlapping of the successive images. In other words, the spectrum is not pure. In order to prevent this overlapping, two important modifications must be made in Newton's arrangement. First, the light must be allowed to pass through a very *narrow* aperture, and, secondly, a sharp *image* of this aperture must be formed by a lens or mirror.

The first improvement was introduced by Wollaston in 1802, who writes:—"If a beam of daylight be admitted into a dark room by a *crevice* one-twentieth of an inch broad, and received by the eye at a distance of 10 or 12 feet through a prism of flint glass held near the eye, the beam is seen to be separated into the four colours only—red, yellowish-green, blue, and violet. . . . The *line* that bounds the red side of the spectrum is somewhat confused. . . . The *line* between the red and green . . . is perfectly distinct; so also are the two limits of the violet. There are other distinct lines (in the green and blue . . .)."

The second improvement was effected by Fraunhofer, 1814, and by observing the light which fell from such a narrow aperture upon a prism by means of a *telescope* he discovered upwards of 750 *dark* lines in the solar spectrum, and mapped their position and general character.

In recognition of the enormous importance of this discovery, these lines are always known as the Fraunhofer lines.

A minor inconvenience in Fraunhofer's arrangement lay in the fact that the slit source had to be at a considerable distance from the telescope; and this was obviated in the apparatus of Bunsen and Kirchhoff, 1860, which is essentially the same as the modern spectroscope of to-day, consisting of a slit and collimator, prism, and observing (or photographic) telescope.

On this beautifully simple device rests practically the whole science of spectroscopy, with all its wonderful applications and all the astonishing revelations of the structure and motions of the sidereal universe and of the constitution of the atoms of matter of which it consists—nay, even of the electrons of which these atoms are built!

Without the telescope it is evident that the science of spectroscopy would be as limited in its field as was the science of astronomy without the telescope. It is interesting, indeed, to compare the progress of the two sciences as dependent on the successive improvements in the two instruments.

Without the telescope nothing could be discovered concerning the heavenly bodies (with the exception of a few of the more evident features of the sun, the moon, and the comets) except the brightness and places of the stars and the motion of the planets, and even these could, at best, be very roughly determined (say, to within one part in five thousand, or something over a half-minute of arc). Without the telescope spectroscopy would also have been limited to observations of general differences in character of radiations and absorptions, and a rough determination of the position of the spectral lines, with a probable error of this same order of magnitude.

In fact, the *resolving power* of the eye is measured by the number of light waves in its diameter, about 5000, and if a double star (or a double spectral line) presents a smaller angle than 1/5000 it is not "resolved." The resolving power of a telescope with a 1-inch objective would be about 100,000, so that details of the solar and lunar surfaces, and of planets, nebulæ, and of double stars and star groups can be distinguished the angular distance of which is of the order of 1/100,000. The discs of the planets, the rings of Saturn, the moons of Jupiter, and some star groups and clusters, begin to be distinguishable. Our largest telescopes have a resolving power as high as 2,000,000, corresponding to a limit of separation of one-tenth of a second.

But in order to realise the full benefit of the telescope when used with a prism, the latter must be so large that the light which falls upon it entirely fills the object glass. The efficiency of the prism then depends on its size and on its dispersive power.

In order to form an idea of the separating or resolving power in spectroscopic observations it will be convenient to consider the Fraunhofer line D of the solar spectrum or the brilliant yellow line corresponding to the radiation given out by a salted alcohol flame. This Fraunhofer recognised as a double line, and the length of the light-waves of the components are approximately 0·0005890 mm. and 0·0005896 mm. respectively. The difference is, then, 6/5893 of the whole, or about 1/1000, requiring a prism of resolving power of 1000 to separate them. If the prism were made of flint glass with a base of 25 mm. it would just suffice to show that the line was double.

Now we know of groups of spectral lines the components of which are much closer than those of sodium. For instance, the green radiation emitted by incandescent mercury vapour consists of at least six components, some of which are only a hundredth of this distance apart, and requiring, therefore, a resolving power of 100,000 to separate them. This means a glass prism of 100 inches, the construction of which would present formidable difficulties. These may be partially obviated by using twenty prisms of 5 inches each; but owing to optical imperfections of surfaces and of the glass, as well as the necessary loss of light by the twenty transmissions and forty reflections, such a high resolving power has not yet been realised.

The parallelism of the problems which are attacked in astronomy and in spectroscopy is illustrated in the following table. It is interesting to observe how intimately these are connected and how their solution depends on almost exactly the same kind of improvement in the observing instruments, particularly on their *resolving power*: so that not only are the older problems facilitated and their solution correspondingly accurate, but new problems, before thought to be utterly beyond reach, are now the subject of daily investigation.

Astronomical.	*Spectroscopic.*
(1) Discovery of new stars, nebulæ, and comets.	Discovery of new elements.
(2) Star positions.	Wave-length of spectral lines.
(3) Double stars and star clusters.	Double lines, groups, and bands.
(4) Shape and size of planets and nebulæ. (?) Star discs.	Distribution of light in spectral "lines."
(5) Star motions (normal to line of sight). Resolution of doubles. Solar vortices. Protuberances, &c.	Star motions (parallel with line of sight). Resolution of doubles. Solar vortices. Protuberances, &c.
(6)	Changes of character and position of lines with temperature, pressure, and magnetic field.

(7) Spectroheliograph.
(Combination of telescope and spectroscope.)

[1] Address of Dr. A. A. Michelson, retiring president of the American Association for the Advancement of Science, delivered at the Washington meeting of the Association on December 27, 1911.

We must especially note that the newer problems require an enormous resolving power. In the telescope this has been accomplished partly by the construction of giant refractors and partly by enormous reflectors: and, curiously enough, the same double path is open to spectroscopy; for we may employ the analogous dispersive power of refracting media or the diffractive power of reflecting media. The increasing cost and difficulty of producing large transparent and homogeneous blocks of glass have tended to limit the size and efficiency of lenses and of prisms, and these have been more or less successfully replaced, the former by mirrors and the latter by *diffraction gratings.*

These are made by ruling very fine lines very close together on a glass or a metal surface. The effect on the incident light is to alter its direction by an amount which varies with the wave-length—that is, with the colour; and a spectrum is produced which may be observed to best advantage by precisely the same form of spectrometer, with a substitution of a grating for the prism.

The dispersion of a diffraction grating depends upon the closeness of the rulings; but the resolving power is measured by the total number of lines. It is important, therefore, to make this number as large as possible.

The first gratings made by Fraunhofer, 1821, contained but a few thousand lines, and had a correspondingly low resolving power—quite sufficient, however, to separate the sodium doublet. A considerable improvement was effected by Nobert, whose gratings were used as test objects for microscopes; but these were still very imperfect as spectroscopic instruments, and it was not until Rutherford, of New York, 1879, constructed a ruling engine with a fairly accurate screw that gratings were furnished which compared favourably with the best prisms in existence.

With 30,000 lines (covering more than 40 mm.) the theoretical resolving power would be 30,000; practically about 15,000—sufficient to separate doublets the components of which were only one-fifteenth as far apart as those of the sodium doublet.

An immense improvement was effected by Rowland, 1881, whose gratings have been practically the only ones in service for the last thirty years. Some of them have a ruled surface of 150 mm. × 60 mm., with about 100,000 lines, and can separate doublets the distance of which is only 1/100 of that of the sodium doublet in the spectrum of the first order. In the fourth order it should resolve lines the distance of which is only one-fourth as great.

Practically, however, it is doubtful if the actual resolving power is more than 100,000, the difference between the theoretical and the actual performance being due to the defect in uniformity in the spacing of the grating furrows.[1]

The splendid results obtained by Rowland enabled him to produce the magnificent atlas and tables of wave-lengths of the solar spectrum which are incomparably superior in accuracy and wealth of detail to any previous work; so that until the last decade this work has been the universally accepted standard. With these powerful aids it was possible not only to map the positions of the spectral lines with marvellous accuracy, but many lines before supposed simple were shown to be doublets or groups; and a systematic record is given of the characteristics of the individual lines, for example, whether they are intense or faint, nebulous or sharp, narrow or broad, symmetrical or unsymmetrical, reversed, &c.—characteristics which we recognise to-day as of the highest importance, as giving indications of the structure and motions of the atoms the vibrations of which produce these radiations.

One of the most difficult and delicate problems of modern astronomy is the measurement of the displacement of spectral lines in consequence of the apparent change of wave-length due to "radial velocity" or motion in line of sight. This is known as the Doppler effect, and had been well established for sound waves (a locomotive whistle appears of higher pitch when approaching and lower when receding); but it was only confirmed for light by Huggins and by Vogel in 1871, by the observation of displacements of the solar and stellar spectral lines.

It may be worth while to indicate the accuracy necessary in such measurements. The velocity of rotation of the sun's equator is approximately 2 kilometres per second, while the velocity of light is 300,000 kilometres per second. According to Doppler's principle, the corresponding change in wave-length should be 1 : 150,000—a quantity too small to be "resolved" by any prism or grating then in existence. But by a sufficient number of careful micrometer measurements of the position of the middle of a given spectral line, the mean values of two such sets of measurements would show the required shift. It is clear, however, that if such radial velocities are to be determined with any considerable degree of accuracy, nothing short of the highest resolving power of the most powerful gratings should be employed.

Another extremely important application of spectroscopy to solar physics is that which, in the hands of Hale and Deslandres, has given us such an enormous extension of our knowledge of the tremendous activities of our central luminary.

The spectroheliograph, devised by Hale in 1889, consists of a grating spectroscope provided with two movable slits, the first in its usual position in the focus of the collimator, and the second just inside the focus of the photographic lens. A uniform motion is given to the two slits so that the former passes across the image of the solar disc, while the other exposes continually fresh portions of the photographic plate.

If the spectroscope is so adjusted that light of the wave-length of a particular bright line in a solar prominence (say, one of the hydrogen or the calcium lines) passes through the instrument, then a photograph of the prominences, or sun-spots, or faculæ, &c., appears on the plate. But the character of this photograph depends on the portion of the bright spectral "line" which is effective, and as the entire range of light in such a line may be only a thirtieth part of the distance between the sodium lines, it would require a resolving power of at least 100,000 to sift out the efficient radiations so that they do not overlap.

As another illustration of importance of high resolving power in attacking new problems, let us consider the beautiful results of the investigations of Zeemann on radiation in a magnetic field. The effect we know is a separation of an originally simple radiation into three or more, with components polarised at right angles to each other. This is one of the very few cases where it is possible actually to alter the vibrations of an atom (electron), and the fact that the effect is directly calculable, as was first shown by Lorentz, has given us a very important clue to the structure and motions of the atoms themselves.

The experiment is made by placing the source of radiation (any incandescent gas or vapour) between the poles of a powerful electromagnet and examining the light spectroscopically. Now this experiment had been tried long before by Faraday, but the spectroscopic appliances at his disposal were entirely inadequate for the purpose.

Even in the original discovery of Zeemann only a broadening of the spectral line was observed, but no actual separation. In fact, the distance between components which had to be observed was of the order of a hundredth of the distance between the sodium lines, and in order to effect a clear separation, and still more to make precise measurements of its amount, requires a higher resolving power than was furnished by the most powerful gratings then in existence.

As a final illustration, let us consider the structure of the spectral "lines" themselves. Rowland's exquisite maps had shown many of these, which were then thought simple, to be double, triple, or multiple, and there are clear indications that even the simpler lines showed differences in width, in sharpness, and in symmetry. But the general problem of the distribution of light within spectral lines had scarcely been touched. Here, also, the total "width" of the line is of the order of 1/100 of the distance between the sodium lines, and it is evident that without more powerful appliances further progress in this direction was hopeless.

Enough has been said to show clearly that these modern problems were such as to tax to the utmost the powers of the best spectroscopes and the experimental skill of the most experienced investigators.

Some twenty years ago a method was devised which, though somewhat laborious and indirect, gave promise of

[1] This applies to all the Rowland gratings which have come under my notice, with the exception of one which I had the opportunity of testing at the Physical Laboratory, University, Göttingen. The resolving power of this grating was about 200,000.

furnishing a method of attack for all these problems far more powerful than that of the diffraction grating.

Essentially, the extremely simple apparatus which is called the *interferometer* consists of two plane glass plates. These can be made accurately parallel, and their distance apart can be varied at will. When light is reflected from the surfaces which face each other, the two reflected beams of light waves "interfere" in such a way as to add to each other, giving bright maxima, or to annul each other's effect, producing dark spaces between.

The alternations of light and darkness which occur when the eye observes in the direction of the normal are very marked so long as the plates are very near together; but as this distance increases the interferences become less and less distinct, until at a distance, *which depends on the character of the incident light*, they vanish completely. A perfectly definite relation holds between the "visibility curve" and the character of the radiation, so that the one can be deduced from the other.

Now the "resolving power" of such an apparatus is measured by the number of light waves in the doubled distance between the surfaces. This is about 100,000 for a distance of 1 inch; but the distance is, in fact, *unlimited*, and as the instrument itself is practically free from errors of any sort, its resolving power is practically unlimited.

The use of this method of light-wave analysis is attended with certain difficulties, and the results obtained are not always free from uncertainties; but in view of the fact that at this time no other methods of this power had been devised, it has amply proved its usefulness. Among the results achieved by it may be mentioned the resolution of many lines supposed single into doublets, quadruplets, &c.; the measurement of their distances apart; the distribution of light in the components; the measurement of their width and the changes produced in them by temperature, pressure, and presence of a magnetic field.

Among the radiations thus examined, one proved to be so nearly homogeneous that more than 200,000 interference bands could still be observed. Otherwise expressed, the exact number of light waves in a given distance, say 10 cm., could always be determined, and by a comparison with the standard meter the absolute wave-length of this radiation could be measured and made to serve as a basis for all wave-lengths.

The standard of length itself, the standard metre, is defined as the distance between two lines on a metal bar; and notwithstanding all the care taken in its manufacture and preservation, there is no assurance that it is not undergoing a constant slow change, doubtless very small, but perhaps appreciable by the refinements of modern metrological methods if there were any fundamental unchangeable standard with which it could be compared. The earth's circumference was supposed to be such a standard, and the metre was originally defined as the millionth part of an earth-quadrant; but the various measurements of this quadrant varied so much that the idea was abandoned. The attempt to base the standard on the length of a seconds-pendulum was no more successful.

But we have now the means of comparing the standard metre with the length of a light wave (the standard metre contains 1,553,163 waves of the red radiation from cadmium vapour), so that should the present standard be lost or destroyed, or should it vary in length in the course of years, its original value can be recovered so accurately that no microscope could detect the difference. True it is that in the course of millions of years the properties of the atoms which emit these radiations and the medium which propagates them may change—but probably by that time the human race will have lost interest in the problem.

The difficulties in the application of the interferometer method of investigating the problems of spectroscopy, it must be admitted, were so serious that it was highly desirable that other instruments should be devised in which these difficulties were avoided. This need was supplied by the "echelon," an instrument based on the same principle as the diffraction grating, but consisting of a pile of glass plates of exactly equal thickness and forming a kind of stairs, whence its name.

The grating acts by assembling light-waves the successive wave trains of which are retarded by some small whole number of waves (usually less than six, the distance between the grating spaces being about six light waves), whereas this retardation in the echelon is many thousand.

But the resolving power depends on the *total* retardation of the extreme rays, and this may be made very large either by having an enormous number of elements with small retardations, or by a comparatively small number of elements with large retardations. For example, an echelon of thirty plates of glass 1 inch thick, each producing a retardation of 25,000 waves, would have a resolving power 750,000, about seven times that of the grating; and this high value has actually been realised in practice.

Simultaneously, Perot and Fabry showed that by the repeated reflections between two silvered surfaces[1] a very high resolving power is obtained, and a few years later Lummer devised the plate interferometer, which embodies practically the same idea.

The resolving power of all of these newer devices is clearly many times as great as that of the grating; but all equally share the objection which holds (but to a far less extent) for the grating—that the different succeeding spectra overlap. It is true that this difficulty may be overcome (though with some loss of simplicity and considerable loss of light) by employing auxiliary prisms, gratings, echelons, &c., and in this form all these modern instruments have contributed results of far-reaching importance, which would have been impossible with the older instruments.

The diffraction grating possesses so many advantages in simplicity and convenience of manipulation that it is even now used in preference to these modern instruments, except for such refinements as require an exceptionally high resolving power. But has the resolving power of the grating been pushed to the limit? We have seen that this depends on the number of rulings; and it is certainly possible to increase this number. But the theoretical value is only reached if the rulings are very accurately spaced; for instance, the resolving power of the Rowland grating is only one-third of its theoretical value. This is a direct consequence of inaccuracies in the spacing of the lines. If a grating could be constructed of, say, 250,000 lines with exact spacing, the resolving power would be equal to that of the most powerful echelon. The problem of the construction of such gratings has occupied my attention for some years; and while it has met with some formidable difficulties, it has had a fair measure of success, and gives promise of still better results in the near future.

The essential organ in all ruling engines in actual use is the screw, which moves the optical surface to be ruled through equal places of the order of a 50th to 100th of a millimetre at each stroke; and the principal difficulty in the construction of the machine is to make the screw and its mounting so accurate that the errors are small compared with a thousandth of a millimetre.

This is accomplished by a long and tedious process of grinding and testing, which is the more difficult the longer the screw. A screw long enough to rule a 2-inch grating could be prepared in a few weeks. Rowland's screw, which rules 6-inch gratings, required two years or more; and a screw which is to rule a grating 15 inches wide should be expected to take a much longer time, and, in fact, some ten years have been thus occupied.[2]

I may be permitted to state a few of the difficulties encountered in this work, some of which would doubtless have been diminished if my predecessors in the field had been more communicative

First is the exasperating slowness of the process of grinding and testing the screw. This cannot be hurried, either by grinding at greater speed or by using any but the very finest grade of grinding material. The former would cause unequal expansions of the screw by heating, and the latter would soon wear down the threads until nothing is left of the original form.

Secondly, in ruling a large grating, which may take

[1] Boulouch, 1893, had observed that Na rings were doubled both by reflexion (grazing incidence) and transmission (normal incidence) with a light silver film.

[2] A method of ruling gratings accurately, which is independent of any mechanical device, is now in process of trial, in which the spacing is regulated by direct comparison with the light waves from some homogeneous source such as the red radiations of cadmium.

eight to ten days, the ruling diamond (which must be selected and mounted with great care) has to trace a furrow several miles long on a surface as hard as steel, and often breaks down when the grating is half finished. The work cannot be continued with a new diamond, and must be rejected and a new grating begun.

Thirdly, the slightest yielding or lost motion in any of the parts—screw, nut, carriage, or grating—or of the mechanism for moving the ruling diamond, is at once evidenced by a corresponding defect in the grating. When, after weeks, or sometimes months, of preparation all seems in readiness to begin ruling, the diamond point gives way, and as much time may have to be spent in trying out a new diamond.

When the accumulation of difficulties seems to be insurmountable, a perfect grating is produced, the problem is considered solved, and the event celebrated with much rejoicing, only to find the next trial a failure. In fact, more time has been lost through such premature exhibitions of docility than in all the frank declarations of stubborn opposition!

One comes to regard the machine as having a personality—I had almost said a feminine personality—requiring humouring, coaxing, cajoling, even threatening! But finally one realises that the personality is that of an alert and skilful player in an intricate but fascinating game who will take immediate advantage of the mistakes of his opponent, who "springs" the most disconcerting surprises, who never leaves any result to chance, but who nevertheless plays fair, in strict accordance with the rules of the game. These rules he knows, and makes no allowance if you do not. When *you* learn them, and play accordingly, the game progresses as it should.

As an illustration of the measure of success attained in this work, I would direct attention to a recent comparison by Messrs. Gale and Lemon of the performance of a grating of 6½-inch ruled surface with that of the echelon, the Perot and Fabry interferometer, &c. The test object is the green radiation from incandescent mercury vapour. The spectrum of this radiation had been supposed a simple line until the interferometer showed it to be made up of five or more components. The whole group occupies a space about one-fifteenth of that which separates the sodium lines.

The grating clearly separates six components, while the more recently devised instruments give from six to nine. Two of these components are at a distance apart of only 1/150 of the distance between the sodium lines, and these are so widely separated by the grating that it would be possible to distinguish doublets of one-half to one-third this value, so that the actual resolving power is from 300,000 to 400,000—of the same order, therefore, as that of the echelon.

It may well be asked, why is it necessary to go any further? The same question was put some twenty years ago when Rowland first astonished the scientific world with resolving powers of 100,000, and it was his belief that the width of the spectral lines themselves was so great that no further "resolution" was possible. But it has been abundantly shown that this estimate proved in error, and we now know that there are problems the solution of which depends on the use of resolving powers of at least a million, and others are in sight which will require ten million for their accurate solution, and it is safe to say that the supply will meet the demand.

To return to our comparison of the telescope and the spectroscope; while the progress of investigation of the stellar universe will be ever furthered by increased size and resolving power of the telescope, this is very seriously hampered by the turbulence of the many miles of atmosphere through which the observations must be made. But there is no corresponding limit to the effective power of spectroscopes, and the solution of the corresponding problems of the subatomic structures and motions of this ultramicroscopic universe may be confidently awaited in the near future.

The messages we receive from the depth of the stellar firmament or from the electric arcs of our laboratories, come they in a millionth of a second or in hundreds of light-years, are faithful records of events of profound significance to the race. They come to us in cypher—in a language we are only beginning to understand.

Our present duty is to make it possible to receive and to record such messages. When the time comes for a Kepler and a Newton to translate them we may expect marvels which will require the utmost powers of our intellect to grasp

THE CARBONISATION OF COAL.[1]

I.

BEFORE it is possible to explain the highly complex actions taking place in the destructive distillation of coal, it is important to have some definite idea of the nature of the raw material with which we have to deal; and although many attempts have been made to gain an insight into the composition of coal, the wide variations in its characteristics, the difficulties attending any attempt to separate its constituents, and the ease with which the products of its decomposition undergo secondary changes at the temperatures employed in breaking it up, have prevented any very satisfactory solution of the problem being arrived at.

The one thing generally admitted is that coal is the fossil remains of a vegetation that flourished in the carboniferous period of the world's history, and that it has passed through successive stages of checked decay; the action of time, temperature, and pressure, generally out of contact with air, resulting in the conversion of these into the tertiary coals (such as brown coals or lignites), and probably by a continuance of the action yielding eventually the true coal.

All the plants of which we have fossilised record in our coal measures consisted of sedges and reeds, tree ferns, club mosses or lycopodia, and trees akin to the pine; but in those prehistoric days the conditions of growth—warmth, moisture, and carbon dioxide—were such that these plants grew with a succulent freedom and rapidity unknown in latter days, and which rendered their tissues an easy prey to decay and fermentation—actions which left only the more resistant unchanged. The work of Morris, Carruthers, Fleming, and Huxley has shown us that the bituminous matter in coal is largely derived from the spores of fossil mosses akin to the lycopodia. If we take the club mosses of to-day, we find their spores give us the body known as lycopodium—a substance so resinous in its nature that it resists the action of water, and is used to coat pills, while the same resinous characteristics render it so inflammable that a little blown through a flame provides the theatrical world with its artificial lightning. Spores of this character, from the giant growths of the carboniferous period, together with the more resinous portion of plants akin to the pine, are the substances which have best resisted the actions taking place during the ages that have elapsed in the formation of coal.

Starting with the fibre of the original plants, we find two well-defined bodies—cellulose, as represented by cotton fibre, and lignose, as represented by jute fibre. In the former, the percentage of carbon is 44, in the latter 47—each giving distinctive reactions with dilute acids at 70° C., with anilin sulphate, with Schultze solution, and with mixtures of sulphuric and nitric acids. In the cellular tissue, we find starch; and besides these bodies, there are present the extractive and mineral matters of the sap.

Among the extractive matter we find gums—such as those exuding from the acacia and cherry, but also present in the juice of many plants—mucilage, vegetable jelly (which gives many juices their power of gelatinising), resins, essential oils, and other well-defined bodies. With some forms of vegetation, the essential oils undergo oxidation and form resins; and these, being more resistant to change, accumulate in masses of decaying vegetable matter, so that large quantities of them are found in lignite beds in a fossilised, but little changed, state.

The changes in the carbohydrates and extractive matters depend largely upon the conditions of decay. Given moisture and air, they become converted into carbon dioxide and water; check the decay by cutting off free access of

[1] From a course of Cantor Lectures given at the Royal Society of Arts in November and December, 1911, by Prof. Vivian B. Lewes.

air, the action is slowed down, and the gases evolved are carbon dioxide and methane.

It is clear that in a mass of rotting vegetation undergoing checked decay, fermentation must play an important part; and Renault found, in an extensive series of researches upon peat, that the most important factor in the conversion of vegetable deposits into peat was fungi and bacterial ferments, which give rise to the production of ulmic compounds of the composition: Carbon 65·31, hydrogen 3·85, oxygen 30·84. Mulder also, at an earlier period, found that bodies could be extracted from peat, to which he gave the name of humic and ulmic acids; and Einof, Proust, and Braconnot found that such bodies formed the chief portion of peat.

These humus bodies have also been frequently identified in the lignites and also in the true coals.

None of these bodies are probably definite compounds, and resemble the residues obtained by the action of dilute acids on sugar and starch. The evidence, however, seems to point to the presence in all bituminous forms of coal of degradation products of the original vegetation of a humus or ulmic character, and which is probably the portion carrying the nitrogen; and in round numbers the proportions of the carbon, hydrogen, and oxygen will be not far removed from: Carbon 62 per cent., hydrogen 5 per cent., oxygen 33 per cent.

It is also well known that tertiary coals, like the brown coal and lignite deposits, are rich in fossil gums and resins, derived from the extractive matter of the vegetation; and a number of these have been isolated and analysed; whilst it is evident that in coal there are resin bodies of this character approximating to the general composition: Carbon, 79 per cent.; hydrogen, 11 per cent.; oxygen, 10 per cent.

The amount of resin constituents in the original vegetation, and which concentrates itself in the coal, must play an important part in chemical changes taking place during the formation and ultimate composition of the coal; and it is clear that although the vegetation that flourished in the coal age was of a very different character from that of later periods, yet in all probability the variations in the extractive matters of the plants varied to much the same extent as in the flora of to-day. Thus some deposits would be formed from vegetation containing but little of the resin-forming constituents, while others would be rich in them. We know the wide differences there are in the physical characteristics of the lignites—sometimes more like wood than coal, at others black, shining, and with a conchoidal fracture; these variations in appearance being due to the conditions under which they have been formed and the amount of resin constituents present.

If we start with the humus and resin constituents as they exist in the peat deposits of to-day, the latter are present only to the extent of 5 to 10 per cent.; but in the decaying vegetation of the carboniferous age, they were probably present in much larger quantities. The humus, unprotected by it, rapidly undergoes decomposition, with concentration of carbon and evolution of methane, carbon dioxide, and water. As the layers of deposit above the carbonising mass grow thicker, so probably the temperature rises. The ratio of resin constituents increasing in proportion binds together the mass, and so helps to protect the remaining humus; and with the lapse of centuries lignite is formed. If the amount of resin constituents has been small, or, owing to local circumstances, has not been distributed evenly throughout the mass, the lignite is loose in structure, and during the ensuing ages continues decomposing until, if the pressure has been great and the temperature high, nothing but the residual basis and trace of resin constituent are left in the form of steam coal or anthracite. Under other conditions they may remain mixed with the bituminous coal in a seam and form the "mother of coal."

If the percentage of resin bodies has been very high —as in a drifted deposit of spores from lycopodia—and the temperature has been high, the resin bodies may become semi-liquid, and, mingling with surrounding earthy deposits, will give such compounds as boghead cannel, the organic matter in which has the same composition as resin, while it yields 33 per cent. of ash. Some of the cannels, however, are simply very rich bituminous coals. When the temperature has been high enough, some of the resin constituents practically distil into the underlying clay, yielding some forms of shale.

Heat also may cause isomeric and other changes in the resin bodies, thus altering their behaviour towards solvents; while the effect of heat under pressure upon the resins is in some cases to decompose them, with formation of hydrocarbons, a long series of which were isolated by Renard—among them being both saturated and unsaturated groups, together with hydrocarbons containing oxygen. Hydrocarbons, like retene ($C_{18}H_{18}$), have frequently been isolated; and this body is found in many lignites. Within the last few months, Pictet and Ramseyer have isolated hexahydrofluorene ($C_{13}H_{16}$) and others of the hydroaromatic hydrocarbons from coal—bodies which are resolved into aromatic hydrocarbons and hydrogen on destructive distillation. Renard long ago isolated not only saturated hydrocarbons like pentane and hexane, but also hexahydrides or naphthenes isomeric with the ethylene series, from the resin oil obtained by distilling wood resin at a low temperature (350° C.); among these hexahydrides being C_7H_{14}, C_9H_{18}, and $C_{10}H_{20}$. The presence of bodies of this character in low temperature coal tar is a further proof of the presence of the resin bodies in coal.

All these degradation products of the original vegetation are to be found in the bituminous coals, the residual body and humus forming the basis, which is luted together by the hydrocarbons and resins; and the characteristics of the various kinds of coal are dependent upon the proportions in which the four groups of the conglomerate are present. These constituents of the coal have their own characteristic products of decomposition when the coal is subjected to carbonisation. The humus bodies during carbonisation yield a large proportion of the gaseous products, and under the influence of heat show no sign of melting, but begin to break up at about 300° C. The decomposition becomes more rapid as the temperature rises. Water distils over in the early stages; the tar is thin and poor in quantity, and the gases up to 600° C. consist of hydrogen, methane, and carbon dioxide, with smaller quantities of carbon monoxide and traces of other saturated hydrocarbons. The decomposition can be completed below 800° C.; but if the temperature is run up to 1000° C., the carbon dioxide is reduced in quantity by the action on it of the red-hot carbon. Carbon monoxide increases correspondingly, while hydrogen and methane are still evolved.

The decomposition of the humus is also largely affected by the rate of heating. If slowly heated, a large proportion of the oxygen is given off in combination with hydrogen as water vapour, while if quickly raised in temperature more combines with carbon to form carbon dioxide and monoxide. The residue shows no sign of caking, while, like the naturally formed residue—mother of coal—it requires a large proportion of cementing material to make the particles cohere. The resin bodies and hydrocarbons which form the cementing portion in the coal melt between 300° C. and 320° C.; and if a coarsely powdered sample of the coal becomes pasty or semi-fluid at this temperature, it is a strong inference that the coal will coke on carbonisation—a fact noted by Anderson, and which is very useful in practice as a rough test. About these temperatures, also, the resin bodies and hydrocarbons begin to decompose.

The resin bodies at low temperature yield saturated hydrocarbons, unsaturated, chiefly hexahydrides or naphthenes, together with some oxygenated compounds; while the hydrocarbons yield paraffins and liquid products—all these primary constituents undergoing further decompositions at slightly higher temperatures. The liquids so produced begin to distil out as tar vapours and hydrocarbon gases, and leave behind with the residuum pitch, which at 500° C. forms a mass already well coked together if the residuum from the humus is not too large in quantity. The coke formed at this temperature is, however, soft; but if the heat be raised to 1000° C. the pitch residue undergoes further decomposition, yielding gas and leaving carbon, which binds the mass into a hard coke.

It has been shown by Muck and other observers that it is not always the coal containing the largest amount of volatile matter that evolves gas most rapidly or is richest

in hydrocarbons, and this naturally follows from the fact that the coals which have the highest oxygen percentage are mostly those giving high volatile matter. As these are rich in the humus bodies which yield most of the diluting gas and but little tar or rich hydrocarbon gases, they cannot give the high result of a coal in which the oxygen content is about 10 per cent. or rather lower, and which contains a large percentage of resin bodies.

Experience shows that the weathering of coal is a phenomenon which is dependent upon the absorption of oxygen from the air; and this weathering is fatal to the coking of some coals, the slacks of which are so susceptible to oxidation that a few days' or weeks' exposure destroys their coking power. Now the avidity of oxygen for some vegetable resins is well known; the rapidity with which copal will absorb oxygen from the air may be taken as an example. Common resin has itself been formed by the oxidation of turpentine, and countless ages under conditions tending to reduction may well have whetted anew the resinic appetite for oxygen. In any case, the resin bodies are the compounds present in the coal most likely to possess this property; and it is the chemical actions so caused which lead to slow combustion, and, when accelerated by any rise in the surrounding temperature, is capable of generating sufficient heat to lead to the spontaneous ignition of masses of broken coal large enough to prevent the escape of the heat as it is developed.

Coal exhibits, to a lesser extent, the same property of absorbing gases that charcoal does. The least absorbent will take up one and a quarter times its own volume of oxygen, while many bituminous coals will absorb more than three times their volume of the gas. This action, at first largely physical, presents the oxygen in a probably active condition to the resin bodies in the coal, and leads to the rapid "weathering" and destruction of the coking properties found with some kinds of coal.

Boudouard has shown that when coal is weathered humus bodies are produced, and the coking power is lessened or destroyed. In seven samples of various coals the humus constituents were increased by the oxidation, which seems to show that the action of the absorbed oxygen is to attack the resin compounds; and as we know that carbon dioxide and moisture are the chief products of the earlier stages of heating of masses of coal, it seems probable that the result is a conversion of resinic into humus bodies with evolution of these gases. It is this change that leads to the serious deterioration in the gas and tar made from coal which has been too long in store; while the fact that a cannel coal like boghead or a shale does not weather is partly due to its dense structure, and also, in the same way, is an indication that the resin bodies of which it is chiefly composed are of a different type—a fact borne out by their resistance to certain coal solvents which freely attack the ordinary resin matter.

It has been shown that the coals richest in resin bodies are the cannels, whilst those that contain most of the residues of the humus bodies and least of the resin constituents are the steam coal and anthracite, and between these extremes come the large class of bituminous coals.

Many classifications of coal have been suggested, some based on their chemical, some on their physical, and others on their coking properties. Of the latter, the most generally adopted is that suggested by Gruner, in which he tabulates bituminous coals into five classes. Although Schondorff, Muck, and others have shown that it is not applicable to all kinds of coal, still this criticism applies to all classifications that have been proposed.

		Carbon	Hydrogen	Oxygen
1. Dry Coal ...	Long flame and non-coking ...	75–80	4·3–5·5	13·0–18·5
2. Fat gas coal ...	Coke porous and brittle	80–85	5·0–5·8	10·0–13·2
3. Semi-fat or furnace coal	Good coke, but porous... ...	84–89	5·0–5·5	5·5–10·0
4. Coking coal ...	Best coke ...	89–91	4·5–5·5	4·5– 5·5
5. Lean coals and anthracite ...	Non-coking ...	90–93	3·0–4·3	3·0– 4·5

This arrangement shows not only the coking properties, but also the changes in composition which the coal undergoes, the concentration of carbon, and reduction in highly oxidised bodies. In the first class we have the dry coals, yielding large volumes of gas and liquid products on distillation; and these—as might be expected—most resemble the lignites, and share with them the property of non-coking or binding together of the residue on carbonisation. This is due to the fact that the humus-like bodies are still present in much larger quantities than the resinic compounds and hydrocarbons, and as on distillation they leave no binding material in the residue, the resinic bodies cannot supply enough to give more than a friable mass.

In the second class of coals, altered conditions of temperature, pressure, and time have led to further decompositions of the humus bodies, and the resinic constituents and hydrocarbons having increased in ratio by concentration, a point is reached at which coking takes place, although not of a really satisfactory character.

In the third class, the action has still continued with further concentration of the resin bodies, hydrocarbons, and residuum, with the result that the former bodies are so increased in comparison to the humus and residuum that a good coke results, although, for reasons that will be discussed when speaking of coking processes, it is rather too porous and bulky.

In the fourth class, the proportion of resin and hydrocarbon bodies has reached the right ratio as compared with the humus and residuum, and the best coking coal is obtained. Bituminous coals of the kind classified by Gruner may therefore be looked upon as an agglomerate of humus and the degradation products of these bodies down to carbon, luted and protected by resin bodies and their derivatives; steam coal and anthracite as the degradation products of humus which has nearly completed its decomposition owing to the small quantity of resin bodies in the original vegetation; cannel coal as consisting mainly of resin bodies, which, having been in a semi-fluid condition, have mingled with the earthy matter in contact with it, so obtaining the high ash found in many kinds.

In putting forward this theory as to the composition of coal, I wish it distinctly understood that by the terms "humus" or "resin" bodies I do not imply any one definite compound, but merely bodies of this character—the humus bodies all containing a percentage of hydrogen from 5 per cent. downwards, while the resin bodies all contain a percentage of hydrogen above 5 per cent. If it is once admitted that coal is a conglomerate of the kind I have indicated, it explains all those obscure points which no other theory touches—such as why with two coals of almost identical composition and of high oxygen content one should be a coking and the other a non-coking coal, the reason being that in the one the high oxygen content is due to humus bodies, which will not coke owing to the low pitch-forming nature of the hydrocarbons, while with the other the oxygen is due to resin bodies, which are essential to good coking.

In 1898 Anderson and Roberts, as the result of a long research upon the chemical properties of Scotch coals, came to the conclusion that a considerable part of the organic matter in coal consists of a complex compound comparatively rich in nitrogen, and also containing sulphur, and that there is also present resinous material, while the remaining constituents are composed of degradation products of the original carbohydrates of the coal plants, a theory which in its essentials agrees very well with my views on the subject.

During the present year (1911) Burgess and Wheeler have published the results of a series of experiments upon the distillation of coals at various temperatures which lead them to conclude that coal contains two types of compounds of different degrees of ease of decomposition. The more unstable decomposes below 750° C., and yields on distillation the paraffin hydrocarbons and no hydrogen; the other decomposes only at or above 750° C., and yields hydrogen only, or possibly hydrogen and oxides of carbon. The latter they suppose to be a degradation product of cellulose; the former to be derived from the resins and gums from the coal plants. The authors consider that the difference between one coal and another is determined by the proportion in which these two types exist in the coal.

All the evidence that can be adduced shows that when a coal undergoes destructive distillation all the hydrocarbons, together with the resin and humus constituents, undergo decomposition at a temperature certainly well below 700° C., and that as the liquid and gaseous products distil out they leave behind their less volatile residues as a pitch, which lutes together the carbon particles and forms soft

coke; while as the temperature rises above 750° C., the pitch residue decomposes, yielding hydrogen, carbon monoxide, and methane as gases, while the carbon residue from the pitch binds the residual mass into coke. It is this residual pitch that Burgess and Wheeler have mistaken for a primary constituent of coal.

It is clear, however, that (putting detail on one side until our knowledge has been broadened by experience) the answer to the question as to what is the composition of coal—whether the answer is derived from a consideration of the actions taking place during its formation and of the substances from which it was derived, or is obtained from analytical data, as was done by Anderson and Roberts, or from the products of distillation, as has been done by Burgess and Wheeler—must be that coal is a conglomerate of humus and its degradation products with the resinic bodies and their derivatives.

(In the second lecture of the series, Prof. Lewes traced the alterations in the methods of carbonisation from Murdoch's pot stills to the latest forms of gas-making retorts, showing the reasons that led to the horizontal iron retort, its gradual replacement by fire-clay retorts, the introduction of the inclined retort, and the improvements in gas settings.)

Since 1893, when the advent of the incandescent mantle as a practical method of developing light began to do away with the necessity for gas of high illuminating value, so general became the adoption of the mantle that in 1900 applications began to be made in Parliament in various Gas Bills to reduce the standard of light for those companies whose previous average had been about 16 candles, it being felt that a 14-candle gas was better fitted for yielding light with the incandescent mantle, power in the gas engine, and for heating in gas stoves than higher qualities; and it also gave the possibility of economies in manufacture, which it was hoped might lead to lowering of the price of gas to a point at which it would better compete with fuel gas for power purposes.

During the last ten years there has been an amount of activity in attempts to alter the process of gas manufacture which has exceeded any that has taken place since the first few years of its inception, and this new era may be considered to have started with the inauguration of the vertical retort, in which, by utilising a large oval fire-clay retort set on end with a slight taper from bottom to top, much larger charges could be used than had been possible with the horizontal or inclined retorts, and in which also gravity was utilised to the full for charging and discharging.

The vertical retort dates back to 1828, when it was first introduced by John Brunton, who, finding that the gas could not escape freely from the lower portions of the charge, and so created considerable pressure, put a perforated pipe in the centre of the charge to afford an easy way of escape. Nothing more was heard of the process, so it probably failed; but at later dates attempts of the same kind were made by Lowe and Kirkham and also by Scott.

After these early experiments nothing seems to have been done for sixty years until the summer of 1903, when Settle and Padfield put up a vertical retort at Exeter, and Dr. Bueb started experimenting on the subject in Germany.

Vertical retorts during the last few years have met with great success on the Continent, and their use has spread with the greatest rapidity.

In England it has been felt that, good as are the results obtained with the vertical retort working intermittently, i.e., by putting in a full charge of coal, carbonising and drawing, and then recharging in the same way as with the old form of retorts, great improvements could be effected by making the process continuous, as was first attempted by Settle, so approaching more nearly to uniform conditions of carbonisation. Vertical retorts on this principle have been devised by Messrs. Duckham and Woodall, and by Messrs. Glover and West, and they certainly show results which will lead to continuous carbonisation being one of the most important factors in the future of gas manufacture.

The economies to be derived from carbonisation in bulk have on the Continent led to still further advances in the size of the charge, and little more than three years ago chamber carbonisation was introduced at Munich, in which charges of 3 to 8 tons of coal can be dealt with at a time, and this method also has met with a large amount of success, a number of installations having been erected on the principles laid down by Ries, Koppers, and others.

Many observers felt that the old horizontal retort could be made to yield better results than had hitherto been obtained, and Mr. C. Carpenter, at the South Metropolitan Gas Company's works, found that great advantages may be obtained by packing the old horizontal retorts full of coal, as had been suggested by Kunath in 1885, instead of only partly filling them, this doing away with the large space that had always been left above the charge of carbonising coal, and so eliminating to a great extent the baking of the gases and contact with the heated crown of the retort, this giving a distinct advance in make and quality not only in the gas, but in the tar.

Whilst these changes in form have been taking place, improvements in the settings, gas fuel, and regenerative firing have made such strides that the temperatures employed are limited only by the nature of the refractory materials used, and the result of these higher temperatures with light charges is to largely increase the volume of the gas obtainable per ton of coal, but at the same time its illuminating value is reduced, and the tar is deteriorated, and it also gives rise to stoppage of ascension pipes and an increase in naphthalene troubles in the service.

When iron retorts were used, the temperatures that could be employed were limited by the softening point of the iron, and rarely rose above 800° C., and although only 9000 cubic feet of gas were made per ton of coal, the gas was rich in heating and lighting value, and the tar excellent in quality. The advent of the fire-clay retort, as has been seen, enabled temperatures to be increased, and 10,000 cubic feet of gas was the general yield. With the introduction of regenerative firing, the volume of gas obtained rose to 11,000 cubic feet, whilst the more modern developments approach a yield of 13,000.

In all these changes the gas manager has been actuated by the desire to get the greatest volume of gas possible per ton of coal, and at the same time to do it with the greatest economy, and but little attention has been paid to the quality of the tar and coke, which have been looked upon as by-products. In point of fact, the tar, when temperatures were pressed to their highest in lightly charged horizontal retorts, became so poor and choked with naphthalene and free carbon as to be almost valueless.

The introduction of large masses of coal in carbonisation, for reasons which will be discussed fully later, has led to distinct improvements in this respect, and although there is no modern tar which approaches in value the product of the old iron retort, the improvement in many places of late has been very marked.

(The gradual growth of the coke-making industry was then dealt with from the Meiler heap to the modern coke recovery ovens.)

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The following are among the courses that will be held in the Faculty of Science at University College during the present term:—"General and Geological Aspects of Palæobotany," by Dr. Marie Stopes, on Tuesdays at 4 p.m., beginning on January 16; "Instruments and Maps," by Mr. M. T. Ormsby, on Tuesdays at 4 p.m., beginning on January 23; "Vertebrate Palæontology," by Prof. J. P. Hill, on Tuesdays at 5 p.m., beginning on January 23. In connection with the Francis Galton Laboratory for National Eugenics, Prof. Karl Pearson will deliver two lectures on "Sir Francis Galton," on Tuesdays, January 30 and February 6, at 8.30 p.m., to be followed on subsequent Tuesdays by a course of six lectures on "Some Problems of Eugenics."

WE learn from the *Revue Scientifique* that M. Georges Leygues has just given 25,000 francs to the University of

Paris in aid of the new Institute of Chemistry, and that M. David Weill has made a third donation of 30,000 francs to the University.

BUILDINGS costing nearly 200,000*l.* are, says *Science*, either being constructed or will be started at the University of Wisconsin before the next academic year opens. Nine new structures will be completed within the next twelve months on various parts of the University grounds. The new buildings and their cost will be as follows:—Biology hall, 40,000*l.*; wing to library, 33,000*l.*; home economics building, 23,000*l.*; model high school, 30,000*l.*; women's dormitory, 30,000*l.*; agricultural chemistry, 18,000*l.*; chemistry building wing, 15,300*l.*; horticultural building, 11,400*l.*; gymnasium annexe, 3000*l.*

A COURSE of ten lectures on illuminating engineering will be given on Tuesday evenings at the Northampton Polytechnic Institute, St. John Street, London, E.C., commencing January 16. The lectures are intended for a technical audience, and each lecture will be given by a specialist in the particular subject. The subjects of the lectures are:—"The Nature of Light and of Radiation"; "Photometry and the Measurement of Light"; "The Production of Electric Light and its Distribution"; "The Chemistry of Gas Manufacture and Lighting"; "The Use of Shades and Reflectors"; "Physiological Factors in Illumination"; "The Practical Use of Arc Lamps"; "The Practical Use of Metallic Filament Glow Lamps"; "The Practical Use of Gas Lamps."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, December 20, 1911.—Mr. H. G. Plimmer, F.R.S., president, in the chair.—F. Shillington **Scales**: The photomicrography of the electrical reactions of the heart. The lecturer described the principle and construction of the Einthoven string galvanometer, with especial reference to the optical arrangements and the methods of photographing the movements of the wire, resulting from the differences in potential set up by the heart-beat. Photomicrographs of the movements of the hearts of various animals under the influence of drugs were shown.—Rev. Hilderic **Friend**: British Tubificidæ. The author first gave a brief historical sketch, alluding to the work of Lankester, Beddard, and Benham, and the various Continental and other authorities who have in past years written on the family. After showing the difficulties attending definition, and the value of the setæ for the purposes of classification, the author proceeded to arrange the British species in two classes:—(1) those genera which are destitute of capilliform setæ; and (2) those which possess them. These two groups are again subdivided, and no fewer than thirty species, besides some subspecies and varieties, are placed on record, of which ten are described for the first time, and sixteen have been added by the author during the year. Specially interesting is the discovery of a new genus, named Rhyacodrilus, containing two species, of which one (*R. bichaetus*, Friend) is new to science. These two species are as yet known only in Derbyshire. Ilyodrilus is now definitely recorded as British, with no fewer than five species.

Linnean Society, December 21, 1911.—Dr. D. H. Scott, F.R.S., president, in the chair.—Rev. Hilderic **Friend**: Some annelids of the Thames Valley.

DUBLIN.

Royal Irish Academy, December 11, 1911.—Rev. Dr. Mahaffy, president, in the chair.—W. F. de V. **Kane**: Clare Island Survey Reports.—Butterflies and moths. The lepidopterous fauna of Clare Island is relatively poor, and shows a marked preponderance of northern species. The island affords a second Irish habitat for *Dasydia obfuscaria*, a remarkably melanic variety. The coast sandhills of Achill and of isolated points on the adjoining mainland are noteworthy for the occurrence of *Nyssia zonaria*, and the discontinuous range of this species, with its wingless female and sluggish herb-eating larva, presents an interesting and difficult problem to the student.—F. Balfour **Browne**: Water-beetles. Ninety species of water-beetles are now known to occur in the Clare Island district. Amongst these are some uncommon species, notably *Deronectes griseo-striatus* and *Agabus congener*; the latter insect had not been previously found in Ireland. The local *Octhebius legolissii* occurred on Clare Island. In addition to the full lists of species, a careful analysis is given of the West Mayo water-beetle fauna. The author recognises the occurrence of a distinct west-ranging Irish group of species—of both northern and southern European origin—a fact which has also been noticed in other sections of the fauna of the west of Ireland.—Miss Jane **Stephens**: Fresh-water sponges. Five species of fresh-water sponges were found, namely, *Spongilla fragilis*, *S. lacustris*, *Ephydatia mülleri*, *E. fluviatilis*, and *Heteromeyenia ryderi*. The first-named is new to Ireland. Of the remaining species, *H. ryderi*, a sponge common to North America and the west of Ireland, is very widely distributed throughout the district examined. Different forms of this species are described for the first time from Ireland. The differences between the sponges growing in lakes lying on limestone and those in lakes on non-calcareous rocks are noted.

BOOKS RECEIVED.

Die Chemie der Cellulose unter besonderer Berücksichtigung der Textil- und Zellstoffindustrien. By Prof. C. G. Schwalbe. Zweite Hälfte (Schluss des Werkes). Pp. 273–666+xii. (Berlin: Gebrüder Borntraeger.) 14.80 marks.

Handbuch der bautechnischen Gesteinsprüfung. By Prof. J. Hirschwald. Erster Band. Pp. xi+387. (Berlin: Gebrüder Borntraeger.)

Annuaire Astronomique et Météorologique pour 1912. By C. Flammarion. Pp. 360. (Paris: E. Flammarion.) 1.50 francs.

Mineralogy. By Dr. F. H. Hatch. Fourth edition. Pp. ix+253. (London: Whittaker and Co.) 4*s.* net.

Increasing Human Efficiency in Business. By Prof. W. D. Scott. Pp. v+339. (London: Macmillan and Co., Ltd.) 5*s.* 6*d.* net.

The Rational Arithmetic for Rural Schools. By G. Ricks. Scholar's Book. Third Year's Course. Pp. 48. Fourth Year's Course. Pp. 48. (London: Macmillan and Co., Ltd.) 3*d.* each.

Black's Literary Readers. By J. Finnemore. Book vi. Pp. 268. (London: A. and C. Black.) 1*s.* 9*d.*

Twenty-seventh Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1905–6. Pp. 672. (Washington: Government Printing Office.)

Supplement to the Fourth Report of the Wellcome Tropical Research Laboratories at the Gordon Memorial College, Khartoum. By Dr. A. Balfour, Captain R. G. Archibald, and others. Pp. 448. (London: Baillière, Tindall and Cox.) 15*s.* net

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 18 Lieferung, Band ii., Erste Hälfte. Pp. 1145–1563+x. 19 Lieferung, Band iii., Erste Hälfte. Pp. 160. (Jena: G. Fischer.) 5 marks each.

Complete Yield Tables for British Woodlands and the Finance of British Forestry. By P. T. Maw. Pp. xii+108. (London: Crosby Lockwood and Son.) 7*s.* 6*d.* net.

Shackleton in the Antarctic: being the Story of the British Antarctic Expedition, 1907–9. By Sir E. Shackleton, C.V.O. Pp. 255. (London: W. Heinemann.) 1*s.* 6*d.*

Flashes from the Orient, or a Thousand and One Mornings with Poesy. By J. Hazelhurst. Book four—Winter. Pp. xi+284. (London: Hazell, Watson and Viney, Ltd.) 1*s.* 6*d.* net.

An Intermediate Course of Practical Physics. By Rajanikanta De. Pp. xii+284. (Calcutta: International Publishing Company.)

Willing's Press Guide, 1912. Pp. xiv+489. (London: J. Willing, jun., Ltd.) 1*s.*

Biological Aspects of Human Problems. By Dr. C. A. Herter. Pp. xvi+344. (London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

A Geography of the World. By B. C. Wallis. Pp. xvi+372. (London: Macmillan and Co., Ltd.) 3*s.* 6*d.*

The Chemistry of Bread-making. By J. Grant. Pp. vi+224. (London: E. Arnold.) 5*s.* net.

Memories of a School Inspector: Thirty-five Years in

Lancashire and Suffolk. By A. J. Swinburne. Pp. 274. (Saxmundham: The Author; and London: McDougall's Educational Company, Ltd.) 2s. 6d. net.

Microbiology for Agricultural and Domestic Science Students. Edited by Prof. C. E. Marshall. Pp. xxi+724. (London: J. and A. Churchill.) 10s. 6d. net.

The Metallurgy of Steel. By F. W. Harbord and J. W Hall. 2 vols. Fourth edition. Vol. i. Pp. xvi+522+xxix. Vol. ii. Pp. xviii+523–933+xxix. (London: C. Griffin and Co., Ltd.) 36s. net.

From Constantinople to the Home of Omar Khayyam. Travels in Transcaucasia and Northern Persia for Historic and Literary Research. By Prof. A. V. W. Jackson. Pp. xxxiii+317. (London: Macmillan and Co., Ltd.) 15s. net.

Die Reizbewegungen der Pflanzen. By Dr. E. G. Pringsheim. Pp. viii+326. (Berlin: J. Springer.) 12 marks.

A Text-book of Botany for Colleges and Universities. By Members of the Botanical Staff of the University of Chicago, Drs. J. M. Coulter, C. R. Barnes, and H. C. Cowles. Vol. ii. Ecology. Pp. x+485–964+pp. a—q. (New York, &c.: American Book Co.)

DIARY OF SOCIETIES.

THURSDAY, JANUARY 11.

ROYAL SOCIETY, at 4.30. — On the Propagation of Waves through a Stratified Medium, with Special Reference to the Question of Reflection: Lord Rayleigh, O.M., F.R.S.—On the Variation of the Specific Heat of Water, with Experiments by a New Method: Prof. H. L. Callendar, F.R.S.—The Mechanism of the Semipermeable Membrane and a New Method of Determining Osmotic Pressure: Prof. F. T. Trouton, F.R.S.—Mobility of the Positive and Negative Ions in Gases at High Pressures: A. L. Kovarik.—A New Method of Determining the Radiation Constant: G. A. Shakespear.—The Mechanics of the Water Molecule: Dr. R. A. Houston.

MATHEMATICAL SOCIETY, at 5.30.—Successions of Integrals and Fourier Series: W. H. Young.—A New Condition for the Truth of the Converse of Abel's Theorem: G. H. Hardy and J. E. Littlewood.—On Mersenne's Numbers: A. Cunningham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Some General Principles Involved in the Electric Driving of Rolling Mills: C. A. Ablett.

CONCRETE INSTITUTE, at 8.—Discussion on Two Reports of the Reinforced Concrete Practice Standing Committee: (a) The Standardisation of Drawings of Reinforced Concrete Work; (b) Consistency of Concrete.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5. — Note on Certain Co-efficients appearing in the Algebraic Development of the Perturbing Function: R. T. A. Innes.—Sur la longitude de l'Observatoire de Lille, déterminée par télégraphie sans fil: R. Jonckheere.—The Constitution of the Ring Nebula in Lyra (N.G.C. 6720): J. W. Nicholson.—Observations of Occultations of Stars by the Moon made in the year 1911: Royal Observatory, Greenwich.—An Example of the Use of Spherical Harmonic Analysis: F. G. Brown and H. H. Turner.—A New Form of Observatory Dome: C. P. Butler.

MALACOLOGICAL SOCIETY, at 8.—Note on the Genus Panope Ménard: W. H. Dall.—Nomenclature of the Veneridæ—A Reply to Dr. W. H. Dall: A. J. Jukes-Browne, F.R.S. — The Occurrence of *Helicella heripensis* in Great Britain; Notes on Some British Non-marine Mollusca: A. W. Stelfox.—Characters of Two Undescribed Land Shells from Colombia; Explanation of the Figures Occurring in Westerlund's "Sibirien's Land och Sötvatten Mollusker," 1876; On Two Pre-occupied Specific Names in Gasteropoda: G. K. Gude.

MONDAY, JANUARY 15.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.—The Recruiting of the Employing Classes from the Ranks of the Operatives in the Cotton Industry: Prof. S. J. Chapman and F. J. Marquis.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Colour Discrimination by Artificial Light: T. E. Ritchie.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* Reinforced Concrete Wharves and Warehouses at Lower Pootung, Shanghai: S. H. Ellis.—The Direct Experimental Determination of the Stresses in the Steel and in the Concrete of Reinforced-Concrete Columns: W. C. Popplewell.—Composite Columns of Concrete and Steel: W. H. Burr.

WEDNESDAY, JANUARY 17.

ROYAL METEOROLOGICAL SOCIETY, at 7.45.—Annual General Meeting.—Presidential Address, Some Meteorological Observations: Dr. H. N. Dickson.

ENTOMOLOGICAL SOCIETY, at 8.—Annual General Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—President's Annual Address: On Certain Blood Parasites.

INSTITUTE OF METALS, at 10.30. — A Metallographic Hygroscope: Prof. Carl A. F. Benedicks.—A Study of the Properties of Alloys at High Temperatures: Dr. G. D. Bengough.—Further Experiments on the Inversion at 470°C. in Copper-Zinc Alloys: Prof. H. C. H. Carpenter.—The Influence of Oxygen on Copper containing Arsenic or Antimony: R. H. Greaves.—The Influence of Tin and Lead on the Micro-structure of Brass: F. Johnson.—A Contribution to the History of Corrosion; The Corrosion of Condenser Tubes by Contact with Electro-Negative Substances: Arnold Philip.—The Nomenclature of Alloys: Dr. W. Rosenhain. The Behaviour of Certain Alloys when Heated in Vacuo: Prof. T. Turner.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Physiological Effects of Low Atmospheric Pressures, as observed on Pike's Peak, Colorado (Preliminary Communication): Dr. J. S. Haldane, F.R.S., C. G. Douglas. Prof. Y. Henderson, and Prof. E. C. Schneider.—A paper on the effect of altitude on the dissociation curve of the blood: J. Barcroft F.R.S. — Note on *Astrosclera willeyana* Lister: R. Kirkpatrick. — *Herpetomonas pediculi*, nov. spec., parasitic in the Alimentary Tract of *Pediculus vestimenti*, the Human Body Louse: Dr. H. B. Fantham.—Antelope Infected with *Trypanosoma gambiense*: Capt. A. D. Fraser and Dr. H. L. Duke.

ROYAL INSTITUTION, at 3.—The New Astronomy: Prof. A. W. Bickerton

LINNEAN SOCIETY, at 8.—Some Features of the Marine Flora of St. Andrews: Dr. A. Anstruther Lawson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Old District Records of Bengal: Rev. W. K. Firminger.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion:* Residence Tariffs: A. H. Seabrook.

INSTITUTION OF MINING AND METALLURGY, at 8. A Submerged Flexible joint Main: F. Reed.—Unwatering Tresavean Mine: C. Brackenbury.—Notes on the Operation of Two Winding Engines: H. M. Morgans.—Stoping at the Calamon Mine: C. P. Corbett Sullivan.

FRIDAY, JANUARY 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Evolution and Present Development of the Turbine Pump: Dr. Edward Hopkinson and Alan E. L. Chorlton.

ROYAL INSTITUTION, at 9.—Heat Problems: Sir J. Dewar, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Turbo-blower and Turbo-compressor: G. Ingram.

SATURDAY, JANUARY 20

ROYAL INSTITUTION, at 3.—The Banyoro—A Pastoral People of Uganda; (1) The Milk Customs: Rev. J. Roscoe.

CONTENTS.

THURSDAY, JANUARY 18, 1912.

THE MNEMIC THEORY OF HEREDITY.

Die Mneme als erhaltendes Prinzip in Wechsel des Organischen Geschehens. By R. Semon. Dritte Auflage. Pp. xviii+420. (Leipzig: W. Engelmann, 1911.) Price 10 marks.

THE theory of heredity which is associated more especially with the names of Ewald Hering, Samuel Butler, and Richard Semon, and endeavours to explain the phenomena of inheritance as due to a kind of unconscious memory, on the part of the developing organism, of the experiences of past generations, has not, at any rate in this country, met with a very large measure of acceptance. It is a noteworthy fact, however, that in 1908 Mr. Francis Darwin made it the subject of his presidential address to the British Association at Dublin, and expressed views which correspond very closely with those of the authors mentioned.

The mnemic theory, which is based upon a belief in the inheritance of acquired characters, naturally does not appeal to those who deny the possibility of such inheritance. The position taken up with regard to this question by Prof. Weismann and his followers, however, can scarcely be maintained much longer in face of the rapidly accumulating evidence which, it must be confessed, their unbelief has been perhaps the chief agent in eliciting.

Prof. Semon quotes several instances of this evidence in the work before us, the most convincing of which appears to be that obtained by M. E. Bordage in the case of peach trees. It has long been known that European trees, when grown in tropical or semi-tropical countries, tend to lose their deciduous character and become evergreen. This is the case in the Island of Réunion, where M. Bordage conducted his experiments. He found that in the course of twenty years peach trees imported from Europe become almost completely evergreen. This, of course, is an individual somatogenic, or so-called "acquired" character; but when seeds of these modified trees are sown in certain mountain districts where they are exposed to a considerable amount of frost, they produce young peach trees which are also evergreen, although seeds imported from Europe and sown in similar situations produce normal deciduous trees.

It is true that an attempt has been made with regard to such cases to uphold the Weismannian position by suggesting that the stimulus of changed environment affects both the somatic cells and the germ cells of the parent simultaneously, by what is called "parallel induction," so that the germ cells are modified in a corresponding fashion to the somatic cells, and will therefore give rise to similarly modified offspring; but this certainly looks very like a last attempt to maintain an untenable position, and, in any case, as Sumner and Semon have pointed out, it makes no difference as regards the importance of the action of the environment as a factor in organic evolution whether we suppose the effect upon the germ cells to be produced by "parallel" or by "somatic induction."

The mnemic theory assumes that the germ cells are not, as Weismann would have us believe, shut off from the influence of the body or soma, but that they are, like other cells, and more especially the nerve cells, capable of responding to stimuli by some definite alteration in their condition. The stimuli to which they respond are changes in what Semon calls the "energetic situation" of the whole organism. The effects of such changes are supposed to be impressed upon the germ cells as "engrams," and are of a lasting character.

We may here translate Semon's two mnemic "laws" ("Hauptsätze"):—

First Mnemic Law (*Law of Engraphy*).—All simultaneously acting stimuli within an organism form a coherent simultaneous stimulation-complex, which acts engraphically as such, *i.e.* which leaves behind a coherent and to that extent a unified engram-complex.

Second Mnemic Law (*Law of Ekphory*).—The partial recurrence of the energetic situation, which has previously acted engraphically, acts ekphorically upon a simultaneous engram-complex. To speak more precisely: the partial recurrence of the stimulation-complex which left behind it the engram-complex acts ekphorically upon a simultaneous engram-complex, whether it be a recurrence in the form of the original stimuli or of mnemic stimuli.

It is perhaps scarcely necessary to point out that by "Ekphorie" Semon means the calling forth again of the latent engrams by some appropriate stimulus, whereby they become manifested in the organism.

The condition of the germ cells is thus supposed to be more or less permanently modified by changes in the "energetic situation" of the parent body, and such modifications affect the development of the germ cells because the engrams are called forth in due sequence by appropriate stimuli and express themselves in corresponding modifications of the body of the offspring.

The germ cells are thus stored with the latent "memories" of past generations, and they may contain many engrams that may never get the chance to express themselves in any particular individual ontogeny. Thus a number of alternative routes are open to each individual at the commencement of its life-history, and the particular route followed will depend upon the nature of the stimuli which the developing organism happens to encounter.

Semon finds confirmation of these views in the experiments of Kammerer upon the toad, *Alytes obstetricans*. It is well known that most frogs and toads deposit their eggs in water, where the male embraces the female and squeezes the eggs from her by the pressure of his arms. As the eggs pass out they are fertilised, their gelatinous envelopes swell up, and they adhere together to form the spawn. In adaptation to this habit the forefinger of the male exhibits a characteristic pad or swelling, and the musculature of the forearm is hypertrophied.

In the obstetric toad, on the other hand, sexual union, followed by the fertilisation and deposition of the eggs, takes place on land. The eggs are larger and contain more yolk, and are produced in much smaller numbers. The male assists in the removal of the eggs from the female by means of his hind

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legs, and as there is no water to cause the gelatinous envelopes to swell up, they remain sticky and adhere to his legs. No pads are developed on the forefingers, at any rate in the race with which the experiments were made. Thus these toads have departed widely from the ancestral habits of the Anura, but Kammerer discovered that they could be made to return to those habits in a very simple manner by environmental stimuli.

If the animals are kept at a relatively high temperature (25—30° C.) they are induced to seek the water in order to cool themselves, and there the processes of egg-laying and fertilisation take place. The gelatinous envelopes of the eggs now swell up and refuse to adhere to the legs of the male, and the spawn is accordingly left to take care of itself in the water. The animals become gradually accustomed, during several breeding periods, to this altered mode of procedure, and will at length behave in the same way even at the normal temperature. At the same time, the number of eggs which they lay increases and the eggs become smaller and poorer in yolk, and therefore more like those of ordinary frogs and toads.

More important, however, is the fact that the offspring of these toads are found to be modified in their habits exactly as the parents were. When sexually mature they seek the water, even when kept at the normal temperature, and there unite and deposit their eggs. Still more remarkable is the fact that in the fourth generation of the offspring of these modified toads, kept under the same conditions as the parents, the secondary sexual characters found in frogs and toads which normally lay their eggs in water, and which doubtless occurred also in the ancestors of the obstetric toad, are seen to have reappeared; pads are present on the forefingers of the male, and the musculature of the forearm is hypertrophied. Here, then, we have a case of atavism or reversion brought about by changed environment, and in which crossing or hybridisation has played no part. The ancestral engrams must be latent in the germ cells, and capable of being called forth by the recurrence of the appropriate stimuli; unless, indeed, we suppose that the characters in question have been produced altogether *de novo* by the changed environmental conditions, which seems highly improbable in so short a time.

As regards what we may perhaps call the physicochemical nature of the engrams, Semon adopts a very cautious attitude. Apparently he objects to the idea of material primordia in the germ cells, and purposely avoids molecular interpretations; but he leaves this question entirely open, except in so far as he regards the engrams as being localised, chiefly, if not exclusively, in the nuclei of the germ cells. He also does not attempt to solve the question as to how the necessary stimuli reach the germ cells. That they do reach them, however, appears to be certain from experimental evidence, and that fact is sufficient as a basis for the mnemic theory of heredity.

The fact that this extremely interesting book has now reached its third edition, having been first published in 1904, affords a sufficient indication of the interest which is taken in Germany in the views so ably expressed by its author. ARTHUR DENDY.

BOY LABOUR AND APPRENTICESHIP.

Boy Labour and Apprenticeship. By Reginald A. Bray. Pp. xi + 248. (London: Constable and Co., Ltd., 1911.) Price 5s. net.

QUESTIONS relating to industrial administration and regulation are of special interest in a time of widespread unrest in the working community. A marked improvement in trade has followed a long period of depression. A book on boy labour therefore arrives opportunely. The present production is interesting rather as a representation of the points of view of a London County Councillor than as an aid to the solution of the problems connected with the entry of the adolescent into the working community.

To deal in a book with these problems it is necessary to begin with a clear definition of the problems and to discuss them with direct reference to an actual issue. Mr. Bray recognises this necessity, but he has not escaped from the confusion of ideas which is too common where social problems are the subject, and his proposals for reform are definite only in the form of words in which they are embodied, but are hopelessly too vague to form a basis for any procedure. The confusion begins in the first chapter, on "The Essentials of Apprenticeship." It is stated that an apprenticeship system must satisfy three conditions. First, it must provide for the adequate supervision of the boys until they reach the age of eighteen; secondly, it must offer full opportunities of training, both general and special—the training of the citizen and the training of the worker; lastly, it must lead forward to some opening in the ranks of adult labour, for which definite preparation has been made, and in which good character may find reasonable prospects of permanent employment.

These requirements are followed by a general demand that they are to be applied to all boys; apprenticeship must be universal. How these essentials are to be assured is admitted to controversy, but that they ought to be assured is taken as axiomatic. Now if these essentials and their universal application to all boys are to be admitted, clearly they must not be specifically associated with preparation for industrial efficiency of workers, but applied to all classes of the community, and in this sense in a general way the propositions will not be disputed as a pious expression of desirable possibilities.

If suitable supervision can be provided, most people would be the better for it even after the age of eighteen. All training is good. A job of some kind for everybody is devoutly to be wished. But in proceeding to examine what the author calls the old apprenticeship system, he gets off at a tangent from his definition, forgets that he is dealing only with a very small number of the boys who lived in the time of trade guilds, and that the arrangements which he praises lacked the quality of universality, which lack vitiates the comparison which he proposes between the good old times and the present.

The summary of methods of apprenticeship, not in the sense defined in the first chapter, but in the sense of specific contract between employer and employed with mutual obligations, is interesting, but is marred

by interpolated references to individualism, collectivism, competition, &c.

The historical summary of the early part of the nineteenth century in respect to adolescent labour and the Acts relating thereto is germane to the subject, but all through there is a lack of clearness as to the aim of the arguments and voluminous quotations. The author bewails the bad state of what he calls the industrial system, or industrial organisation, when what he really means is that there was no system and no attention by the community as a whole to the organisation of industry. The decay of apprenticeships which he bewails did not arise from the cupidity or caprice of the employers so much as from the actual disappearance of the handicrafts for which the apprentices were being trained.

Another confusion of ideas occurs in connection with the use of the word "State." The author forgets that the "State" is ourselves. He speaks of the "State" as of some superior aloof deity, who is to carry out the requirements which he has laid down as universal for adolescents. The "industrial system," "the employer," "the capitalist," "the manufacturer," are used as terms antithetical to the "State." Again, the chapter on the guardianship of the State is a short summary of the laws relating to child labour. Here again, however, the author is dealing with a particular part of his general proposition, and when he comes to deal with the question of education he necessarily returns to very vague generalities.

The book closes with a series of "definite" proposals. None of these proposals takes any account of the boy's own attitude to the question.

1. That the school age should be raised to fifteen.
2. That the boy should be under the supervision of Government officials until he is eighteen. That the Labour Exchanges and the Advisory Committees attached to them are to keep in touch with every boy by official and voluntary visitors during these three years.
3. That the employment of boys between fifteen and eighteen should be restricted to half-time.
4. That they should be regularly medically inspected during those years.
5. That the Advisory Committees in connection with the Labour Exchanges should find jobs for all boys.

The author omits to make any suggestions for the specific organisation of the vast additional public service outlined, except that he places it in the hands of the Board of Trade. Still less does he show how the community—that is to say, ourselves—is to be induced to go on working for our offspring until all of them are eighteen years of age, or to beg from our neighbours who have none the means wherewith to feed and clothe them. It is quite simple to put these functions on the "State" as a duty, but it does not look quite so simple when we call the "State" by its other name.

He does not realise that the London County Council may go much farther in making social experiments than the State can, and that London is becoming a bad place for the study of social economics other than those associated with its own special conditions. The taxable capacity of London is considerable, and it is therefore a good place for sanguine people imbued with "the sentiment of humanity" and "imaginative reason" to make social experiments from which other parts of the country may learn useful lessons both of a negative and positive character.

The happy picture of elementary and secondary education under the County Council will amuse some of its ill-natured critics, and the suggestion that all the youths of the country should be subjected to the supervision of the "State" or the L.C.C. until they are eighteen years old, because parents and employers are no longer to be trusted to discipline and train except as voluntary assistants to Advisory Committees at the Labour Exchanges, will seem humorous to anyone who can appreciate a solemn jest.

BRITISH AND IRISH FRESH-WATER FISHES.

The Fresh-water Fishes of the British Isles. By C. Tate Regan. Pp. xxv+287. (London: Methuen and Co., Ltd., 1911.) Price 6s.

MR. REGAN is to be congratulated upon the publication of this little manual, which should find a place in the library of every person who takes an interest in the natural history of our islands. The lack of a convenient manual of moderate size and modest price must often have been felt by many besides ourselves, and this want has been well supplied by the book now before us. Concise but adequate descriptions are given of all fishes native to the fresh waters of these islands, including such marine and estuarine species as are known to ascend into fresh water, and in our opinion Mr. Regan's work marks a distinct step in advance of any of its predecessors. The figures have been drawn by the author himself, and are well adapted for showing the salient features of the fishes illustrated; in one or two instances they have been drawn from examples which have barely attained the characters of adult fish, but this is not really a matter of very great moment, for the changes due to age, sex, and maturity in each species are generally pointed out in the text and the size of the examples figured is given. The importance of the latter information is, unfortunately, not always as fully appreciated by those who describe fishes as by those who have to identify particular individuals with the aid of the descriptions and figures given.

The vast bulk of our fresh-water fishes are either salmonids or cyprinoids, and the treatment of these families by Mr. Regan is in some respects fuller than that accorded by any earlier author. Probably few families provide greater puzzles for the framer of specific definitions than the Salmonidæ, and it is not to be expected that the course adopted by Mr. Regan in recognising no fewer than fifteen species of char and eight of whitefish will commend itself to all his readers. What constitutes a species is, however, a question upon which any person in possession of the requisite information may form his own views; the point of practical importance is that Mr. Regan has given us by far the fullest extant descriptions of the numerous forms (whether regarded as species, subspecies, races, or varieties) of char and whitefish found in the lakes of Great Britain and Ireland. In this he

has been aided by the excellent series of specimens now in the collection of the Natural History Museum, the formation of which was, we believe, largely due to his own exertions, and it is much to be hoped that it will not be long before this series is completed by the addition of examples from any lakes the char or whitefish of which are still unrepresented in the national collection.

Although the whitefish of Lochs Lomond and Eck, of the English lakes, and of Bala Lake were treated by Mr. Regan as subspecies of a single species in 1908; he now treats them on pages 121–5 as representing three substantive species, but states on p. 263 that they "are only local forms of one species, which is closely related to *Coregonus wartmanni* of the Alps, to forms inhabiting Scandinavia, and to anadromous Arctic species." Both this and his statement that the "species" of char are "of quite another nature from widely distributed forms, such as the pike or roach," give some indication of the difficulty which he has himself felt in adopting his present position.

The cyprinoids present a difficulty of a quite different nature; they are normally gregarious fishes, many well-defined species of which are found in the same waters, and the rudd is proverbial in northern Europe for its disregard of specific distinctions when on the spawning-beds. In these circumstances natural hybrids are by no means infrequent, and in carefully describing and often figuring these Mr. Regan has rendered readily available information which was previously only accessible to those who were conversant with purely scientific literature.

The results of recent researches into the life-histories of the salmon and the eel are carefully and clearly summarised, and some information as to the life-histories of other species is given; but the statement that the eggs of the roach are shed on the bottom is, if not inaccurate, at least not universally true. We cannot blame Mr. Regan for the very inadequate accounts given of the breeding, eggs, and larvæ of many species, for these are matters which have been much neglected by naturalists and particularly by British and Irish naturalists, and the available information is, at the best, somewhat meagre. We think, however, that descriptions (and dimensions) ought to have been given of the eggs and larvæ of such fishes as the shads, the pike, and at least one typical cyprinoid; such information is to be found in the works of Continental writers, and is of considerable practical value both to the naturalist and the fisherman.

Care has been taken throughout to verify the size and weight attained by each species, and, in the case of the pike, the history of the great fish of Loch Ken is given in some detail, and an account of the large pike taken when Whittlesea Mere was drained is given in an appendix.

The final chapter, which deals with the origin and geographical distribution of our fresh-water fishes, is, perhaps, one of the most interesting in a book which throughout reflects great credit upon both author and publishers, and deserves to become a standard work.

L. W. B.

STUDIES OF BIRD-LIFE IN UGANDA.

Studies of Bird-life in Uganda. By Dr. R. A. L. van Someren and V. G. L. van Someren. (London: John Bale, Sons, and Daniellson, Ltd., 1911.) Price 1*l.* 11*s.* 6*d.* net.

THESE studies comprise more or less beautiful photographic pictures of the red-headed woodpecker, Egyptian goose, sacred ibis, stone curlew (thicknee), little green-backed heron, sandpiper, rufus-necked nightjar, bateleur eagle, darter, cormorant, black and white African chats, paradise fly-catcher, hagadash ibis, whydah finch, black-headed shrike, crowned crane, and pied kingfisher. The last-named is an excellent picture. That of the crowned cranes is also of interest as showing the appearance of the immature bird at a stage not usually illustrated in museums. The red-headed woodpeckers are also fine pictures. There are some charming studies of ibis and of the little green heron on its nest with eggs; of the darters on their nests amongst the trees, and an excellent figure of their white, downy young; and a characteristic representation of the black chat with a white splash across the wing, which is such a constant and charming feature in Uganda landscapes.

But in a general way it cannot be said that this collection of pictures is remarkably illustrative of bird-life in Uganda. The picture of the Egyptian goose might have been done even better in St. James's Park. The sandpiper also might have come from many other parts of the world, and there are studies of the mature crowned crane issued from the London Zoological Gardens which are better pictures than the one here given. In fact, when we consider the extraordinary wealth of bird-life in Uganda (a wealth scarcely equalled elsewhere in the whole continent, since we have in Uganda a mingling of western, eastern, northern, and southern forms), the reviewer is a little surprised that the authors should not have devoted their photographic skill to a wider and more typical selection. For example, they could have done a great deal to clear up for science disputed points about the marabou stork. Marabous abound in the Uganda Protectorate, and snapshots of the flying marabou would have shown us conclusively whether (as I maintain) it flies with neck outstretched, or whether, as other observers declare, with neck withdrawn, as in the case of herons.

It should not either have been beyond the opportunities of the van Somerens to have given us pictures in a wild state of the *Balaeniceps rex*; or of the splendid blue plantain-eater of the Uganda forests, or the smaller and equally handsome violaceous plantain-eater, especially when the tameness of these birds is taken into consideration. Then there is the handsome saddle-billed stork. There are many types of heron and egret, of duck and goose, never seen in English parks, of barbets and hornbills, which might have been as easily illustrated as the world-wide stone curlew or cormorant.

The notes which accompany these well-executed photographs are of considerable interest. The native name of the bird is always given, together with char-

acteristic stories and proverbs concerning the birds (in one or two instances these are rendered in broken English, which is scarcely necessary, since they are not likely to have been given to the authors in that form). The nesting habits of the birds, the appearance of the nestlings and of the eggs, the times of the breeding season, are supplied, and here one gets a good deal of new information based on careful observation. Even on the subject of the Egyptian geese the remarks contain novel information, as, for example, those describing their habits as tree-perchers. Unlike the real geese (which, of course, they are not), they would seem to pass the night, not on the water, but perched on trees. Yet the nests are not constructed in trees, as is the case with some allied forms, but in shallow depressions of the ground, and after incubation the young at once resort to the water and apparently do not take to the trees until they are able to fly.

The African chat (*Myrmecocichla nigra*) is well described as a merry-looking bird, and his courting attitude is set forth in words exactly corresponding to the picture drawn by me in my own work on the Uganda Protectorate The authors rightly compare the song of the male chat to that of the blackbird. "After feeding the young he would often perch on an ant-hill near by and burst into song as if in pure joy and pride in a lusty family." These chats are certainly the most lovable birds the traveller can meet with throughout East Africa and Uganda. They are very tame, and have a fancy for frequenting native villages or European encampments. Another creature that is well illustrated by photograph and description is the beautiful paradise fly-catcher (*Tchitrea viridis*).

H. H. JOHNSTON.

CACAO-PLANTING.

Cacao: a Manual on the Cultivation and Curing of Cacao. By J. H. Hart. Pp. x+307. (London: Duckworth and Co., 1911.) Price 7*s*. 6*d*. net.

IT is a curious fact that in spite of the enormous political and financial interests possessed by the United Kingdom in tropical countries, and therefore in tropical crops and products, the technical literature on these subjects should be almost entirely exotic. There is, for example, nothing in English to compare with such works as those of Semler and Wiesner in German, or with the several series of handbooks on tropical crops published in France.

This state of things is no doubt due to the fact that serious, organised instruction in tropical agriculture scarcely exists within the British Empire, though it has been found expedient to undertake such work in Holland, Germany, and France, countries the tropical possessions of which are far less important than ours. There are signs, however, of an increased interest being taken in tropical agriculture in this country, and one of them is the occasional publication of a book of the kind now under review.

A sad interest attaches to this book, since though the author was able to see it through the press, he died before it was published. Mr. Hart was well qualified to write on cacao. During his long career in the tropics, he spent no fewer than eighteen years in Trinidad as superintendent of the Botanical Department, and in that capacity was continuously engaged in dealing with the problems that confront cacao planters. He writes therefore with a full knowledge of the needs of planters, and consequently his book is thoroughly practical from a planter's point of view. At the same time, he recognises the provisional character of many of the deductions drawn from past experience, and lays due stress on the necessity for further investigation, and makes many valuable suggestions as to the direction this should take.

Naturally the book is concerned very largely with cacao cultivation and curing as practised in Trinidad, but since that colony produced in 1910 nearly one-seventh of the world's supply of cacao, and this mostly of high grade; this is not a great disadvantage, since Trinidad practice may well be followed by planters elsewhere.

So far, practically no attempt has been made in cacao-growing countries to keep different varieties of the cacao-tree separate, and as a result most plantations contain many varieties, and yield a mixed product. In forming new plantations, it is desirable that this state of things should be avoided, and for this purpose Mr. Hart recommends, in preference to the sowing of selected seed, the grafting of good but delicate kinds of cacao on hardy "stocks." The work already done in the West Indies seems to indicate that this is practicable on the large scale.

Another equally important problem is that of the curing of cacao by fermentation. Trinidad is fortunate in this respect, since although the plantations contain a mixed population, the mixed produce obtained is easily cured, and routine practices in curing are followed, which give on the whole good results. Mr. Hart is therefore perhaps inclined to attach too little importance to this question. In British West Africa it is not so simple. There the variety of cacao grown is initially poor, and is difficult to cure properly. Further, the native farmers are disinclined to take trouble in the matter, with the result that British West African cacao is of low grade and likely to remain so for some time to come, in spite of the strenuous efforts of the Gold Coast Department of Agriculture to induce natives to improve their methods. Much of the difficulty that surrounds the production of better, native-grown cacao in West African colonies may disappear if the investigations recently carried out by Fickendey result in the application on a large scale of simpler curing methods not involving fermentation.

The two series of problems to which allusion has been made are of peculiar importance to the cacao-grower, but in common with other tropical planters he has to deal with fungoid diseases, insect pests, and depredations by animals, and on these and other equally important matters Mr. Hart gives useful and much-needed guidance. He rightly points out that cleanliness in agricultural operations is one of the best means of avoiding disease in a plantation.

The book contains a number of good illustrations of pods of the chief varieties of cacao, of tools used

in harvesting the pods, and of typical scenes on plantations.

It should be a source of satisfaction to Mr. Hart's friends that he was able to embody in this satisfactory form his unique experience in the cultivation of cacao.

T. A. H.

A YEAR-BOOK OF SCIENCE.

Jahrbuch der Naturwissenschaften, 1910–1911. Sechsundzwanzigster Jahrgang. Unter Mitwirkung von Fachmannern herausgegeben von Dr. J. Plassmann. Pp. xv+458. (Freiburg im Breisgau: Herdersche Verlagshandlung; London: B. Herder, 1911.) Price 7*s*. 6*d*.

A GENERAL survey of scientific progress becomes increasingly difficult, and more valuable when accomplished, as the number of original contributions becomes more unmanageable. The excellent publication of which we have here the twenty-sixth annual volume represents a serious attempt to cope with an equally serious situation. To compress the 6000 or so papers by which physical science is annually enriched into some forty pages seems a hopeless task, and the manner of its accomplishment necessarily depends upon the individual outlook of the enterprising reviewer. He will almost inevitably emphasise some things which are of little value and neglect some which future developments may show to be of fundamental importance. If, however, he limits himself to such matters as have reached a certain degree of conclusiveness, if not a conclusion, he will do good work, and can safely leave the unfinished and inconclusive things to his successor.

Dr. Konen's summary of physics deals with some seventy papers under sixteen different headings, and includes such diverse matters as Lebedef's measurement of the pressure of light on gases, the controversy concerning the possibility of electric charges smaller than that of an electron, and the quantitative study of Brownian motions by Perrin, Chaudesaigues, Seddig, and Siedentopf.

The chemistry section, edited by Dr. Dammann, is mainly practical, and describes such things as Harries's synthesis of rubber from isoprane heated in glacial acetic acid; the chemistry of "Ehrlich-Hata 606," the new specific against syphilis; and the synthesis of racemic adrenaline. The astronomical section, compiled by Dr. Plassmann himself, deals with spectroscopic binaries, variable stars, Mars, comets, and the determination of time and geographical situation, picking out a few papers only, and omitting a large number of contributions of at least equal interest.

Dr. Kleinschmidt, of Friedrichshafen, deals very appropriately with aëronautics and meteorology. Other sections are presented on anthropology and ethnology (Birkner), mineralogy and geology (Wegner), zoology (Recker), botany (Weiss, a very full section), forestry and agriculture (Schuster), geography (Schotte), medicine (Moeser), and technology (Ruegg). An astronomical calendar for 1911 and an obituary for 1910 complete the volume, which, in spite of the German type used, is bound to be of great utility as a first line of reference for the year's scientific progress.

OUR BOOK SHELF.

Engines and Boilers Practically Considered: a Handbook for Young Engineers on the Construction and Working of Steam, Gas, Oil, and Petrol Engines and Steam Boilers. By W. McQuade. Pp. xv+87. (London: G. Bell and Sons, Ltd., 1911.) Price 3*s*. 6*d*. net.

THE author of this little book states that his object has been to treat in a simple, straightforward, and practical manner the various types of engines and boilers met with in general engineering with the view of providing a practical handbook for young engineers in general. Matters connected with the theory of the subject are not touched upon, or to the slightest extent only. The book contains sixty-two illustrations dealing with steam engines, steam boilers, and internal-combustion engines. The text comprises descriptions of these illustrations.

Remembering the class of student for whom the book is intended, one expects that the text and illustrations should be easily followed. In many cases index letters are not used in the drawings, an omission which is not calculated to help the young beginner. The drawings are clear as regards draughtsmanship, but in some cases are out of proportion, and a few contain minor errors. For example, a marine connecting-rod given on p. 9 has the set screws used for locking the nuts shown with the heads home against the face of the rod, thus rendering the screws useless for the purpose of locking. In some cases additional views of the part under consideration would have been useful.

Some important details are briefly described in the text without any descriptive sketches being given. An idea of the unevenness of treatment may be gathered from the fact that the action of the slide valve occupies eight pages, while a description of a set of triple-expansion surface-condensing engines shown in the frontispiece occupies one page. There is doubtless a place for a well-got-up book on the lines suggested by the author, and the present book, with considerable revision and additions, might be rendered capable of taking this place.

A Text-book of Physiological Chemistry. By Prof. O. Hammarsten. Authorised translation from the author's enlarged and revised seventh German edition, by Prof. J. A. Mandel. Sixth edition. Pp. viii+964. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 17*s*. net.

PROF. OLAF HAMMARSTEN has resigned the chair he held for so many years at Upsala, but one is rejoiced to learn he has not relinquished work in the field where he has done such important service. Original papers from his pen still appear in the journals, and his well-known text-book continues to flourish, and has now reached a seventh German edition. The translation of this has, as in the past, been carried out by Prof. J. A. Mandel, of New York, who has performed what in his preface he terms a labour of love with his usual efficiency.

The book has considerably grown in size since its last edition; every chapter has been rewritten to bring it up to date, but the principal new feature is a chapter on physical chemistry in biology, which has been contributed by Prof. Hedin, Hammarsten's successor at Upsala. This adds considerably to the usefulness of the text-book. A book which has seen seven editions carries its own recommendation; one can merely congratulate its author, and express the hope that he may live to see many more editions through the press.

W. D. H.

The American Annual of Photography, 1912. Vol. xxvi. Edited by Percy Y. Howe. Pp. 328. (New York: The American Annual of Photography; London: G. Routledge and Sons, Ltd., 1911.) Price 3s. 6d.

In these pages the photographic reader will find much that will interest him, for a host of photographic subjects are delightfully treated, and the illustrations are both numerous and good. Turning over the pages one finds some simple hints regarding telephoto lenses, then a brief discourse on the fascinating procedure of taking photographs against the light productive of many pretty pictures. Simple apparatus for photomicrography and sensitising platinum paper are later dealt with, followed by an interesting article on "Daguerreotype Copying." Much useful information is imparted to the reader in the articles on stereoscopic night scenes, botanical photography, colouring photographs, the English cathedrals, &c. Nearly all the various subjects dealt with are well illustrated, and these add greatly to the value of the annual. At the end there is brought together a typical collection of formulæ and tables which will no doubt be found useful to the working photographer. Good indices to the articles, subjects, illustrators, and advertisers facilitate easy references to the various portions of the book.

Einführung in die Mykologie der Nahrungsmittelgewerbe. By Prof. A. Kossowicz. Pp. viii+138. (Berlin: Gebrüder Borntraeger, 1911.) Price 4 marks.

This book deals with bacteria, yeasts, and moulds in their special relation to foodstuffs, and forms a welcome addition to technical bacteriology. Portions of it particularly concern the domestic arts, and would be of service in connection with courses of "domestic or home science," a branch of training which is now coming to the fore. Commencing with a brief introduction on the morphology and methods of study of the organisms dealt with, the subjects of milk, butter, and cheese are first considered. Then follows the more special section of the book, which is devoted to the consideration of the decomposition and preservation of meat and fish, eggs, vegetables, and fruit. In this the various organisms producing the "spoiling" of these foodstuffs are briefly considered, together with the chief methods of conserving food. It is interesting to learn that the air of the Cuxhaven fish market is ozonised, with the result that the fishy odour is destroyed. Finally, the mycology of the bakery, of sugar, and of fodder is briefly described. The book is a very readable one, and is well and sufficiently illustrated.

R. T. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Spectroscopic Methods.

In his interesting address on spectroscopic methods, Prof. Michelson falls into a not uncommon error when he says that, in order to obtain a pure spectrum, "two important modifications must be made in Newton's arrangement. First, the light must be allowed to pass through a very *narrow* aperture, and, secondly, a sharp *image* of this aperture must be formed by a lens or mirror."

Both these modifications were made by Newton himself, and with a clear understanding of their advantages. In "Opticks," Exper. 11, we read:—"In the sun's light let into my darkened chamber through a small round hole in my window—shut, at about 10 or 12 feet from the window, I placed a lens, by which the image of the hole might be distinctly cast upon a sheet of white paper, placed at the distance of six, eight, ten, or twelve feet from the lens. . . . For in this case the circular images of the hole which comprise that image . . . were terminated most distinctly without any penumbra, and therefore extended into one another the least that they could, and by consequence the mixture of the heterogeneous rays was now the least of all."

And further on:—

"Yet instead of the circular hole F, 'tis better to substitute an oblong hole shaped like a long parallelogram with its length parallel to the prism ABC. For if this hole be an inch or two long, and but a tenth or twentieth part of an inch broad or narrower, the light of the image *pt* will be as simple as before or simpler [*i.e.* as compared with a correspondingly narrow circular hole], and the image will become much broader, and therefore more fit to have experiments tried in its light than before."

Again, it was not Bunsen and Kirchhoff who first introduced the collimator into the spectroscope. Swan employed it in 1847, and fully described its use in Edin. Trans., vol. xvi., p. 375, 1849. See also Edin. Trans., vol. xxi., p. 411, 1857; Pogg. Ann., C, p. 306, 1857.

These are very minor matters as compared with what Prof. Michelson has to tell of his own achievements and experiences, but it seems desirable that they should be set right.

R.

Are Eyes ever Autophanous?

The following communication was written about 1889, soon after my change of residence from Collingwood (in Kent) to Slough (in Buckinghamshire), that is, about twenty-three years ago, and having been laid aside, through the intervention of other interests, has now come to light again in weeding the accumulation of half a rather long lifetime. It seemed unadvisable to recast, from memory, what was set down from present observation. At the same time, the form in which those observations are presented required explanation, such as is now offered.

I propose in the present letter to describe some observations of a rather unique character, and have thought that the occasion warrants my coining a word in connection with—though not descriptive of—their general nature. I had never given much credence to the sayings and statements, not infrequently met with, expressive of a rather widely entertained belief that the eyes of some animals, especially those of the feline *genera*, have the property of "shining in the dark," of emitting light, or (as I now venture to describe it) of being *autophanous*. But I saw no prospect of disproving its existence until accident pointed out a ready way of producing the effect, and thus raising a pretty strong presumption as to the true source of the belief. I propose in a few words to put your readers in a position to verify and extend my subsequent experience, and to enable all who try it to judge for themselves whether the suggested explanation is not sufficient, without attributing to the eye a specific inherent luminosity.

About five years ago I was presented with a puppy, of a good breed of collie, the history of which I must briefly summarise by saying that, until I lost him last November, he was my constant companion day and night. His sleeping quarters during the spring and summer months of '84 were in a kennel placed on the landing of a flight of stone steps leading up to a garden door facing my habitual seat in an inner room, so that we could always see each other when the intervening doors were open. When there was a lamp on the table it was not long before I learnt to look for, and generally to see, Bruno's great eyes watching me out of the darkness. It is immaterial now to recall exactly by what successive steps I learnt the essential conditions of the phenomenon: they now seem so obvious. Eventually I was led to use a bull's-eye lantern, the adoption of which opened the wide field of experience of which I will now endeavour to give some particulars. Let it not be supposed that it is enough to direct the light of a lantern upon a dog's eyes. If such were the case, the observation would long since have been made; for it is by no means essential that the dog's sight shall be turned directly upon the source of light, as will presently appear. What is essential, and what makes all the difference between what the holder of the lantern sees and what a

bystander sees, is that the eye of the observer shall be as nearly as practicable in a line with the light and the reflecting eyeball. A policeman, for instance, may go his rounds night after night for years carrying his bull's-eye at the usual waistbelt level, and never have a notion of the numberless pairs of cats' eyes which he would infallibly see along the area rails should he raise it to the level of his face, so as to look closely past his hand. There! I have let out my secret, and it only remains to tell what I have seen in this way.

First, then, as to Bruno. It was my habit to stroll in the garden with him of an evening, and I carried a bull's-eye, by means of which I could always see where he was, provided he was not moving away from me, or otherwise having both eyes hidden. As to the distance, the next observation will give a fair idea. It was the way I generally chose to show the sight to other people. Bruno's greatest pleasure in life—next to accompanying me with a gun—was to run after a ball, and after bringing it back to gnaw it if not prevented. He would always prefer his ball to his food if the former was thrown. His power of scent was something remarkable. Hundreds of times have I thrown his ball—wooden ones, which I turned for him in the lathe as required, owing to his aforesaid destructive practice, like full-sized croquet balls—when it was too dark to see where he was, and he has never failed to find and bring it, being guided as to general direction partly by my action and partly by the sound of the ball falling. Taking advantage of this, I could always send him forth into the darkness with the certainty that he would shortly be seen[1] by anyone holding a bull's-eye properly, returning in the form of a pair of gig lamps bounding towards one in an undulatory fashion most ludicrous to see. Under such favourable conditions fifty yards would be quite an easy distance.

I will now pass on to cats. My experience of cats' eyes is not so varied, but my belief is that, in relation to their size, they reflect more light. I am sure they could be seen, under similar conditions, at eighty yards, for I have seen them *brilliantly* at half that distance. At greater distances there is not the same inducement for a cat to turn her face in the right direction unless she has taken refuge from a dog, say, in a tree. In such cases I have had good opportunities. The greenish light from a cat's eyes—decided greenness at five yards at least—is easily distinguishable from the redness which is so noticeable in that from a dog's.

The next experience I shall mention relates to sheep. I was completely deceived the first time I saw the light in sheep's eyes. A flock had been let into the field adjoining my evening walk without my knowledge, and there had not been any there for, maybe, a fortnight. Moreover, it was in the early days of my discovery of this amusement, and I had not anticipated its range. However that may be, the appearance of a number of lights, moving and stationary, some down in a hollow, all more or less faint and shimmering, gave me quite a turn; for I have never myself seen natural lights of this sort such as we hear of. I believe I solved the riddle by getting over the fence—after ascertaining that the phenomenon was connected, in the aforesaid essential way, with the position of my lantern—and studying it *ambulando*, thereby learning, *inter alia*, that sheep's eyes can be seen singly if the beast is walking past, and, of course, equally well, or even better, as a pair if it is facing you. They are certainly visible at fifty or sixty yards' distance with the light of an ordinary bull's-eye as source.

I have also seen rabbits' eyes, in the same way, sufficiently well to speak positively, but not often enough or under favourable enough conditions to describe precisely. The light was certainly feebly seen at about twenty yards.

I have not seen the like satisfactorily in horses myself, but others have seen it.

Lastly, I have failed to see any trace of it in human eyes, nor have I heard of anyone else doing so.

J. HERSCHEL.

[1] I am told that readers not in the habit of using such lanterns, naturally suppose that the *dog's whole form* would be seen by its light. The fact is, however, that even a strong light of this kind shows objects very feebly at more than ten yards, unless of a light colour. Practically the dog is not seen at all till quite close.

The Weather of 1911.

AFTER my letter on the above subject (NATURE, January 11) had been posted, it occurred to me to investigate to what extent temperature deviations in Egypt are opposite to those in England, and for this purpose I compared the annual mean temperatures at Abbassia (near Cairo) with those for England S.W. and South Wales (Weekly Weather Report, 1908, p. 429). This district was selected because Dr. W. N. Shaw, F.R.S. (NATURE, vol. lxxiii., 1905, p. 175), had already compared rainfall in this region with wind velocity at St. Helena, and I had compared the same rainfall with the volume of the Nile flood (Quart. Journ. Roy. Met. Soc., xxxvi., 1910, p. 341).

In the present case, a coefficient of correlation $-0{\cdot}427 \pm 0{\cdot}097$ was found for the annual mean temperatures from 1877 to 1910. This looked promising, and an analysis by quarters was then undertaken with the result:—

		Temperatures °F.			
		S.W. England		Abbassia	
		Mean	S.D.	Mean	S.D.
1st quarter	$r = -0.724 \pm 0{\cdot}056$	41·6	1·945	57·7	1·607
2nd ,,	$-0{\cdot}277 \pm 0{\cdot}108$	51·6	1·252	75·4	1·423
3rd ,,	$-0{\cdot}165 \pm 0{\cdot}114$	58·5	1·397	80·8	1·316
4th ,,	$-0{\cdot}544 \pm 0{\cdot}083$	46·2	1·557	65·2	1·478
Year	$-0{\cdot}427 \pm 0{\cdot}097$	49·5	0·944	69·8	0·922

The column headed S.D. gives the standard deviation, from which, in conjunction with the means and coefficients of correlation, the equations of regression can be obtained.

The connection between temperature in S.W. England and Lower Egypt, as represented by Abbassia, is certainly real in the first and last quarters, but only plausible in the second. What the physical connection may be is a more difficult problem to solve. In the winter half-year Lower Egypt lies close to the axis of the ridge of high pressure which stretches across the Atlantic, northern Africa, and Siberia, and the variations of weather here are dependent very largely on the position of this ridge. It seems probable that the explanation will be found here, but the physical connection would still require investigation. In summer, on the other hand, Egypt lies on the slope between the Atlantic anticyclone and the Indian monsoon depression, and probably receives its weather from different regions from those which control weather in England.

It is hoped to analyse the interrelations more fully and to investigate the position of the boundary between the regions of positive and negative correlation with S.W. England.

J. I. CRAIG.

Survey Department, Giza, Egypt, January 6.

Microscope Stands.

I HAVE read with interest the article on the above subject in NATURE of December 21 last. It would be interesting to hear if our expert workers agree with the conclusions arrived at.

With regard to the centring of the condenser, in how many of the cheaper Continental stands does one find any accurate means of centring whatever? Also, what grounds are there for the assertion that the mechanical stages on the Continental stands "as instruments of precision are of a higher order than is obtained in the English models"? Then, with reference to the mechanical draw-tube. Which is cheaper, a mechanical draw-tube built with the stand to work with any objective, or a correction collar on each objective? Is the latter arrangement really more accurate than the draw-tube properly used?

I should also like to point out that the worker can easily keep sprung fittings in adjustment for an indefinite period, but ground fittings would require the attention of the repairer. Lastly, is there any evidence obtainable from our most eminent workers with the microscope that the English instrument has lost its former position as the finest scientific instrument of its kind, and that that position is now occupied by the product of a German house?

JOHN A. L. SUTCLIFFE.

Boston Spa, January 5.

UNDER THE GREENWOOD TREE.[1]

TO say that this is a delightful book is not nearly enough, for quite apart from its marked literary excellence it embodies—we were almost writing enshrines—the select experience and seasoned reflection of a man of taste and understanding, who has lived and moved for sixteen years among the things that he writes about. It is one of the best books on Indian sport that it has been our good fortune to read, and from the lyrical dedication "To my ·450" to the final chapter on weapons and explosives, there is scarcely a paragraph that has not salt and savour.

The author's method is as good as his matter and manner. He gives us, first of all, a pleasing map of his district, with all the physical and administrative features plainly marked. Then in forty-four telling pages he completes the introduction to his country, giving in a few terse and relevant sentences a good general idea of its hills, streams, and forests; of its climate and rainfall; of its political oscillations until it became settled by Europeans and fixed in the fabric of the Madras Presidency; and of its economic ups and downs in the way of coffee-planting and gold-mining. How the latter "industry" has changed the face of certain parts of the district (in south-east Wynaad) is so well pictured that we must quote, or cull, the author's words. After acquiring dozens of planting properties, "the various gold companies . . . took no heed of their fine coffee. . . . Weeds soon overtopped the coffee. . . . Fire got in when the hills were burnt according to the annual custom." And now "for mile after mile nothing but an interminable sea of *dhubbay* grass marks the site of what were smiling estates. . . . A wilderness made by the abortive search after gold."

Having given us our bearings in time and space, the author holds up the mirror, and we follow him and his trusty trackers—Paniyas, Karumbas, and other relic jungle-men—after elephants, tigers, leopards, "bison," bear, "ibex," sambur, and other smaller game. Many new and interesting things he tells us about all these animals, and what is not new he recounts with proper emphasis, and with critical appraisement of the observations and opinions of others. For the elephant, tame or wild, he has an intense admiration: he has watched the whole tragedy of an elephant fight under nature's own conditions, and although he knows the sensation of being charged by an enraged tusker, and of bearing off the spoils of victory, he says: "I never see an elephant without a feeling of regret that the death of even the one I shot can be laid at my door, and nothing would now induce me to shoot another unless he were a confirmed 'rogue,' or in self-defence." He maintains, against Sanderson and Blanford, that the elephant is intelligent above all the beasts of the forest; and he considers—with much justice, we think—that the ease with which this animal when captured can be tamed and taught is a proof, not of dulness, but of that highest form of intelligence which quickly adapts itself to a new environment.

FIG. 1.—Needlerock. From "Sport on the Nilgiris."

The author has often been at close quarters—both accidentally and by design—with tigers, and he knows these beasts well, in all their ways and moods; and the outcome of all his experience is that, unless it is wounded, the tiger in Wynaad (where the man-eater is unknown) is a "cowardly beast" in the presence of man. He describes, among other things, the way the jungle-men have of netting and spearing tigers. He once saw a tiger that had been killed, at very close quarters, by a single charge of buckshot; and the sight so impressed him (six pellets were found to have entered the brain), that he is inclined to recommend

[1] "Sport on the Nilgiris and in Wynaad." By F. W. F. Fletcher. Pp. xix+456. (London: Macmillan and Co., Ltd., 1911.) Price 12s. net.

the buckshot method in dealing with a wounded tiger that has to be followed on foot.

Though in many passages—particularly in a short digression on his tame sambur and his other pets—the author reveals a kindly humour, he is far removed from the drossy sentiment of some of the camera sportsmen who regard all killing as murder. He admits that the sporting instinct ("the killing instinct, if you will") may be a brutal instinct, but its brutality does not much trouble him if men "refrain from the killing of any inoffensive animal save a male with a trophy worth the taking."

We like the way in which the author speaks of his native attendants. He always has a good word for them, and if occasionally—for such things are—he is provoked to address a casual hand in terms that are not exactly complimentary, he is always ready to listen to an explanation and to admit extenuating circumstances.

FIG. 2.—The Sambur. From "Sport on the Nilgiris."

There is so little for even a carping critic to gleek at in this excellent book that we almost hesitate to express our surprise that anyone nowadays should talk of malaria as if it were in any direct way due to disturbance of the soil. It is also unexpected to find an author who has so much philosophy in him, and so much sympathy with nature, referring to the mental processes of animals as if they were all a kind of instinct, and appearing to ignore the fact that many illustrious authorities, from Hume onwards, have supported and justified the opinion that the inferences of the higher animals differ from the inferences of the paragon man not in nature, but only in degree.

The illustrations are wonderfully well reproduced, and most of them are extremely good in themselves; but the elephant is far from representing the magnificent creature of the author's election, and the wild dog appears in quite an innocent and dignified disguise.

There is no index; but as the table of contents is very full, and as each chapter deals with one complete subject, no one who is not bound to formulas will miss it.

THE BRITISH SCHOOL AT ATHENS.[1]

IN its sixteenth volume, the "Annual" of the British School at Athens has returned to a manageable size for its format, and in this respect is a great improvement on its immediate predecessors.

The remarkable excavation at Sparta has come to a close, and the description of it ends in this volume. The final work of the season of 1909–10, which is described, consisted chiefly in picking up the pieces that remained. The most important of these was the excavation of the remains of the Mycenæan town near the Menelaïon. These are of interest as showing that the valley of the Eurotas was only occupied in late Mycenæan times; no trace of any period before "Late Minoan III." was found. Of this period houses with typical pottery of that age were discovered. These are described by the director of the School, Mr. R. M. Dawkins, who also sums up the results of the discovery and excavation of the Temple of Artemis Orthia, which has shed such well-deserved lustre on British archæology. This history of the famous sanctuary is traced, from the establishment of the earliest altar on the site by the Dorians, down to Roman times. The importance of this "record" piece of archæological work is evident, and its two

[1] "The Annual of the British School of Athens." No. xvi. Sessio 1909–10. Pp. ix+343+xvii plates. (London: Macmillan and Co., Ltd., n.d.) Price 25s. net.

subsidiary results are equally important: first, the discovery of the Laconian style of vase-painting, and its identification by Mr. Droop with the style previously known as "Cyrenaic"; secondly, the recovery of the great harvest of inscriptions, many of them in Doric dialect, relating to the worship of Artemis Orthia and the contests of the boys at her shrine, which have been published by Mr. Woodward. The director shows how important to the history of Greek pottery is the accurate chronology of the Laconian ware which this excavation has rendered possible. Of inscriptions only a few new ones have been found, which Mr. Woodward publishes. A minor excavation at a shrine of the Eleusinian Demeter at Kalývia tís Sochás, not far off, has yielded some of these. Some early pottery from a site at Geraki is described by Mr. Wace, and Mr. H. A. Ormerod writes on the topography of Bardounia and north-eastern Maina.

Fig. 1.—Remains of the Roman Theatre in the precinct of Artemis Orthia, looking towards Mount Taygetos.

An interesting paper by Mr. C. H. Hawes, on "Some Dorian Descendants?" may fitly be mentioned in connection with the Laconian work. Mr. Hawes has made interesting researches into the skull-form of the modern inhabitants of Maina, the peculiar dialect of which part of Laconia is certainly of Doric origin, and of Sphakia in Crete, where the dialect shows possible Doric peculiarities, and where the native stock has been kept purest from foreign admixture, since the Turks never tried to hold Sphakia, and only once penetrated to its fastnesses. Mr. Hawes shows that the typical skulls of both Mainotes and Sphakiotes show a peculiar brachycephalic form very like that of the Albanians, and since the Dorians certainly came from Illyria, he tentatively regards this as the typical Illyrian-Doric skull-form, and the Mainotes and Sphakiotes as typical Dorians. This may be, but the Albanians are not, and never were, Greeks, any more than the Italians are or were; whereas the Dorians were the most Greek of the Greeks. Doric Greek was probably the freest of foreign admixture; but the Albanian language is totally different from Greek, and forms a distinct Indo-European linguistic sphere, equally apart from Greek, Slav, or Italian. Also this hyperbrachycephalic form of skull is found in Asia Minor, especially among Kurds and Kizilbashes. We doubt the identity of Albanians and Dorians. But the paper is an extremely suggestive one.

The rest of the "Annual" is taken up by a number of interesting minor articles, the most important of which is that by Messrs. Woodward and Ormerod, describing a journey in south-western Asia Minor, where Mr. Woodward has found inscriptions, and Mr. Ormerod important prehistoric sites, with pottery of considerable interest, which he describes. It belongs to a class distinct from that of the Ægean, and the painted sherds perhaps show analogies to the geometric ware found by the Pumpelly expedition at Anau in Turkestan, and by de Morgan at Tepé Musyân (Moussian) and Susa, in Persia.

Mr. Hasluck continues his descriptions of the extant relics of Latin domination in the Ægean, which have been a feature of recent volumes of the "Annual." This year he describes the traces of the Genoese rule and of the Giustiniani in Chios, besides a quaint French inscription recording the conquest of Adalia by Pierre I., King of Jerusalem, in 1361. He also contributes an article on the once-famed medicinal earth, *terra sigillata* or *terra Lemnia*, which was an im-

Fig. 2.—Contrasted Head-forms from Sphakia: Mediterranean (cephalic index 73·4) and Dorian? (cephalic index 88·7).

portant article of Levantine commerce in the Middle Ages. The contemporary specimen of this earth in the Pharmaceutical Society's collection, he says, "can hardly be genuine"; by this we suppose he means that it is probably a British "fake" of the seventeenth century. The modern specimen he gives of the Turkish stamp which used to be the "sigillum" of the earth (now put on clay bowls), reads *tîn makhtûm*, "sealed earth," in Arabic (not "*tini maktoum*," as Mr. Hasluck prints it: *kh* must not be confounded with *k*!). Old specimens of this Arabic seal are figured from Belon by Mr. Hasluck; but why has he printed them all on one side? Or is this the fault of Belon?

Mr. H. R. Hall contributes "An Addition to the Senmut-Fresco" at Egyptian Thebes, which shows Minoan Cretan (Keftian) ambassadors bearing gifts to the court of Queen Hatshepsu. The addition he has found in a drawing by Robert Hay, now in the MSS. Department of the British Museum, made about the year 1837, which shows the fresco as it was then, with additional figures, vases, and a great sword. Mr. Walters notes that the peculiar method of sealing vases in vogue at Mycenæan Sparta is paralleled by Egyptian seals of Roman times; we might carry the comparison further back, for the Egyptians always sealed vases in this way, at a period contemporary with the Spartan specimens. Here is another minor point of similarity between Minoan and Egyptian ways.

FIG. 3.—A Genoese Inscription at Chios.

Prof. R. C. Bosanquet publishes the last of the old finds of the School at Præsos in Crete, in the shape of the Greek inscriptions, and Mr. Woodward contributes new material to the study of Athenian building records of the fifth century B.C. Finally, anthropology is well catered for in Mr. Wace's very interesting description of the modern survivals in North Greece of Dionysiac festivals (which have now degenerated into mere Guy Fawkes *bacchanalia*, accompanied by chicken-stealing and frowned upon by the police), and Mr. W. R. Halliday's critical examination of the Argive festival of the *Hybristika*, in connection with Herodotus's description of the marriage of the Argive women with their slaves on account of the *ὀλιγανδρία* caused by the defeat of Argos by the Spartan King Kleomenes I. (Hdt. vi. 83). He finds the origin of this story in the festival of the *Hybristika*, when the slaves had full licence, and the women donned men's clothing, the men that of women. This custom of "changing 'ats" is found all over the world, as he shows, and is probably the origin of several Greek stories; for instance, he thinks, that of the Cumæan tyrant Aristodemos, who, says Plutarch, "is said to have brought up the boys of free birth to wear their hair in long tresses and to adorn themselves with gold, while he compelled the girls to have their hair cut at the level of their shoulders, and to wear cloaks like youths and little short frocks." However, this tale of a freakish tyrant may be a true one, and not connected with any *hybristika*; the pranks of Greek despots were often peculiar, and sometimes took forms of this sumptuary kind.

The frontispiece to the volume is a reproduction of a colour-photograph, by Mr. Robert Mond, of the Semnut fresco as it is to-day, which gives the most accurate possible representation of its colouring. Mr. Mond has done a good deal for archæology by his excavations of tombs at Egyptian Thebes, and his application of the latest resource of photography to the representation of this important Egyptian fresco, and gift of the picture to the School at Athens for this volume, merit special acknowledgment.

THE WASHINGTON MEETING OF THE AMERICAN ASSOCIATION.

THE sixty-third meeting of the American Association for the Advancement of Science was held in Washington, district of Columbia, on December 27–30, 1911, under the presidency of Dr. Charles E. Bessey, professor of botany in the University of Nebraska.

The meetings began in the morning of December 27 with a meeting of the council, after which sections and affiliated societies proceeded with business meetings and programmes of papers.

The formal opening exercises were held in the Assembly Room of the New U.S. National Museum at 9 p.m. of the same day, the exercises being preceded by a reception from 8 to 9 o'clock. The President of the United States, Mr. Taft, was present at the opening exercises, and delivered an address of welcome, directing attention especially to the close similarity between the attitude of mind of the scientific investigator and that of the judge. Truth, in both cases, is the aim, and the judicial temperament is necessary to the successful scientific man. The secretary of the Smithsonian Institution, Dr. Charles D. Walcott, was to have given a second address of welcome, but was absent through illness.

The president-elect, Dr. Bessey, responded to the address of welcome, and, in view of the fact that the address had been delivered by the President of the United States, took occasion to point out the importance of scientific work to Government affairs, and to urge President Taft to give all his support to scientific bureaus of the Government.

The address of the retiring president, Dr. A. A. Michelson, of the University of Chicago, was then delivered. His subject was, "Recent Progress in Spectroscopic Methods." This address was published in full in NATURE of January 11th.

The meeting, as a whole, is the largest in the history of the association. The actual registration of the association proper was 1402, while members of affiliated societies and others in attendance at the meetings, including very many members of the association who were unable to register, undoubtedly would have swelled the number to more than 2800.

The addresses of the retiring vice-presidents were as follows:—Vice-President Eliakim H. Moore, before the Section of Mathematics and Astronomy, on "The Foundations of the Theory of Linear Integral Equations"; Vice-President E. B. Rosa, before the Section of Physics, on "The Work of the Electrical Division of the Bureau of Standards"; Vice-President George B. Frankforter, before the Section of Chem-

istry, on "The Resins and their Chemical Relations to the Terpenes"; Vice-President A. L. Rotch, before the Section of Mechanical Science and Engineering, on "Aërial Engineering"; Vice-President Jacob Reighard, before the Section of Zoology, on "Adaptation"; Vice-President R. A. Harper, before the Section of Botany, on "Some Current Conceptions of the Germ Plasm"; Vice-President R. B. Dixon, before the Section of Anthropology and Psychology, on "The Independence of the Culture of the American Indian"; Vice-President Theodore Burton, before the Section of Social and Economic Science, on "The Cause of High Prices"; Vice-President F. G. Novy, before the Section of Physiology and Experimental Medicine, on "Carriers of Disease"; Vice-President A. Ross Hill, before the Section of Education, on "The Teaching of General Courses in Science." (Owing to the death of Vice-President Christopher W. Hall, of the Section of Geology and Geography, no address was delivered before that section.)

The meeting showed, as in other recent years, an increased number of affiliated scientific societies of national scope, and was marked by the presence of the strong group of societies of economic character, including the American Economic Association, the American Statistical Association, the American Association for Labour Legislation, the American Sociological Society, and the American Home Economics Association.

As has been the growing tendency in the association, several important symposia were held, and a number of meetings of interest to several sections and societies. Among these may be mentioned a symposium relating to safety in mines; one on aërodynamics, and another on good roads; one on ten years' progress in vertebrate palæontology; one on mineral wastes and conservation, and a joint session of the zoologists and psychologists on questions relating to animal behaviour. A most important conference on psychology and medical education was held at the Government Hospital, in which eminent psychologists and alienists discussed pertinent questions. The Botanical Section held a symposium on soils, and another on modern aspects of palæobotany. Still another symposium was conducted on acapnia and shock.

The council passed resolutions favouring the establishment of a national quarantine and inspection service directed against the introduction of injurious insects and plant diseases, and others favouring the establishment of a national department of health. Reports of delegates to several international congresses were read.

The general committee selected Cleveland, Ohio, for the place of the next meeting, to open December 30, 1912, and recommended to the following general committee that Atlanta, Georgia, be selected for the meeting in the winter of 1913–14. It also expressed the desire that arrangements for a summer meeting during 1915 be made.

The following officers for the ensuing year were elected:—*President:* Dr. E. C. Pickering, director of the Harvard Astronomical Observatory, Cambridge, Mass. *Vice-Presidents* (*or Presidents of Sections*): Section A, E. B. Van Vleck, University of Wisconsin, Madison, Wis.; Section B, A. G. Webster, Clark University, Worcester, Mass.; Section C, W. Lash Miller, Toronto, Canada; Section D, J. A. Holmes, Bureau of Mines, Washington, D.C.; Section E, J. E. Todd, University of Kansas, Lawrence, Kansas; Section F, W. A. Locy, North-Western University, Evanston, Illinois; Section G, D. S. Johnson, Johns Hopkins University, Baltimore, Maryland; Section H, J. Walter Fewkes, Smithsonian Institution, Washington, D.C.; Section I, J. Hays Hammond, New York, N.Y.; Section K, J. J. R. Macleod, Western Reserve Medical College, Cleveland, Ohio; Section L, J. McKeen Cattell, Columbia University, New York, N.Y. *Secretaries of Sections:* Section B, W. J. Humphreys, U.S. Weather Bureau, Washington, D.C.; Section E, George F. Kay, University of Iowa, Iowa City, Iowa; Section K, Waldemar Koch, University of Chicago, Chicago, Illinois. *General Secretary:* Henry E. Summers, Iowa State College, Ames, Iowa. *Secretary of the Council:* H. W. Springsteen, Western Reserve University, Cleveland, Ohio.

The first meteorological gathering in connection with a meeting of the association was held in the Forecast Room of the Weather Bureau on December 28, the second day of the Washington meeting. As the interval of time between the morning and afternoon sessions of the various sections and societies was too short—and the meeting places were too widely separated—to admit of a "meteorological luncheon," in emulation of the British Association, a "meteorological tea" was decided on as the most practicable and agreeable form of gathering for the interchange of ideas among persons interested in the science of weather. After an hour spent in informal intercourse and an inspection of the buildings and installations of the bureau, five-minute talks were given on the subject, "The Relation of Meteorology to Other Sciences" by Prof. A. Lawrence Rotch ("Aëronautics"), Prof. E. B. Frost ("Astronomy"), Prof. Henry Crew ("Physics"), Prof. W. M. Davis ("Physical Geography"), Prof. W. I. Milham ("Education"). The chief of the Weather Bureau, Prof. Willis Moore, gave the address of welcome, and the speakers were introduced by Prof. W. J. Humphreys.

As a whole, both from the point of view of the attendance and the character of papers read and the general interest shown in the symposia, conferences, and important papers, the meeting undoubtedly will rank as the most important ever held.

The social features of the meeting were of great interest, receptions, dinners, smokers, and visits to the many places of interest in and about Washington more than occupying all the time which could be spared from the sectional meetings. The most notable social function was a reception to the lady visitors at the White House in the afternoon of December 28.

NOTES.

On January 21 mathematicians of many countries will meet at the Sorbonne to do honour to M. Gaston Darboux on the jubilee anniversary of his entry at the Polytechnic School. As the successor, first of Liouville, and then of Chasles, M. Darboux has added lustre to two famous chairs, and by his published works has earned a reputation of the very first order. To Englishmen he is perhaps best known by his connection with the Bulletin, his researches on cyclides (in conjunction with Casey), and his admirable treatise on the theory of surfaces. The last-named work, both in style and method, may be compared with Salmon's classical treatises. Like Salmon, M. Darboux has an equal mastery of geometrical and analytical theories, and combines them with the happiest effect; like him, too, he has the power of drawing material from the most diverse sources, and fusing it into a homogeneous whole. In offering him our congratulations, we feel that we are expressing a sentiment shared by all who are acquainted with M. Darboux's scientific work; and we are sure that they will join with us in hoping that his energy and vigour may be long maintained.

THE possibility of the discovery of a remedy for cancer has been advanced a stage by the preparation by Prof. Wassermann, of Berlin, of a substance which possesses a curative action experimentally on cancer of mice. Prof. Wassermann reasoned that since the cancer-cells are growing rapidly, their oxygen requirements would be different from, and greater than, those of the cells of the body generally. He sought for some substance which might interfere with the oxygen supply to the cancer-cells, and finally adopted selenium as a means to do this. The next problem was to convey selenium to the cancer-cells by means of the blood stream, and after testing some hundreds of preparations a compound of selenium with an anilin dye eosin was found to fulfil this condition. If the eosin-selenium compound is injected into a healthy mouse it becomes pink all over, but if into a mouse with a cancerous tumour the tumour only becomes coloured, demonstrating the selective absorption of the substance. After two or three injections of the substance into a mouse the subject of cancerous tumours, the tumours are found to have softened, and after six to eight doses they become cystic, diminish in size, and finally disappear, and no recurrence takes place. The eosin-selenium compound is, however, poisonous, and a certain number of mice succumb under the treatment. Moreover, only small tumours (up to the size of a cherry) are definitely cured; with larger tumours so much disturbance ensues that the animals die.

THE death is announced, at seventy-one years of age, of Dr. Otto Liebmann, formerly professor of philosophy in the University of Jena.

IT is announced in the *Revue Scientifique* that M. Louis Gentil has been elected president of the French Geological Society for 1912, and M. Stanislas Meunier, Général Jourdy, Abbé Bourgeat, and M. Henri Boursault, vice-presidents.

AT the business meeting of the Association of Public School Science Masters on January 11 the following officers were elected for 1912:—President, Sir Archibald Geikie, P.R.S.; chairman, Mr. D. Rintoul, Clifton College; and Mr. D. Berridge, Malvern College, and Mr. F. M. Oldham, Dulwich College, honorary secretaries.

THE Rhodesia Scientific Association's gold medal, recently offered for an original paper advancing the knowledge of the transmission of any insect or arachnid-borne disease affecting Rhodesia, has been awarded to Dr. Edward Hindle, Beit memorial research fellow, for his paper on "The Transmission of *Spirochaeta duttoni*."

THE Geological Society of London will this year award its medals and funds as follows:—Wollaston medal, to Mr. Lazarus Fletcher, F.R.S.; Murchison medal, to Prof. Louis Dollo; Lyell medal, to Mr. Philip Lake; Wollaston fund, to Mr. C. I. Gardiner; Murchison fund, to Dr. Arthur Morley Davies; Lyell fund, to Dr. A. R. Dwerryhouse and Mr. R. H. Rastall.

MR. W. M. COATES, fellow, assistant tutor, bursar and lecturer of Queens' College, Cambridge, and one of the most successful mathematical coaches at the University, died on Tuesday, January 16, in his fifty-fifth year. Mr. Coates entered Queens' College in January, 1884, read mathematics with the late Dr. Routh, and was third wrangler in the Mathematical Tripos, part i., in 1886, and in the following year he was placed in Class I. of Division 2 of part ii. of the Tripos. He examined in the Mathematical Tripos in 1891 and 1892.

MR. F. H. SOMERS-GARDNER sends us a cutting from *The Gibraltar Chronicle* of January 4 which reads:—"On the leg of a seagull which was trapped by some fisher-boys yesterday at the eastern beach was found an aluminium ring bearing the inscription 'Museum Leiden 704.'—J.G.D." In reply to an inquiry, Dr. E. D. van Oort, of the 'S Rijks Museum van Natuurlijke Historie, Leiden, informs us that the seagull referred to is a black-headed gull (*Larus ridibundus*, L.) which was marked June 25, 1911, at Ellemeet, on the island of Schouwen, province Zeeland, Netherlands.

DR. A. R. WILLIS, who for the past forty years had been assistant professor of mechanics and mathematics at the Royal College of Science, South Kensington, retired from his post at Christmas. It is believed that many who have studied under Dr. Willis would welcome an opportunity to express their regard for him, and a committee of past and present students has been formed, therefore, to arrange for the presentation of a testimonial to him on his retirement. Subscriptions should be sent to the treasurer, Prof. A. Fowler, F.R.S., Royal College of Science, South Kensington, S.W., on or before the end of this month.

The British Medical Journal announces that the ninth annual congress of the Association Internationale de Perfectionnement Scientifique, which is under the patronage of the French Government, will be held on August 3–31 in the Balkans, in Turkey, and in Greece. The congress will be opened in Evian-les-Bains or Thonon-les-Bains, and will be continued at various other places. Persons wishing to present communications on subjects belonging to medicine, surgery, and the cognate sciences are requested to intimate their intention to the president, 12 Rue François-Millet, Paris XVI. The general secretary of the congress is Dr. Ghislain Housel.

WE learn from *The Times* that Captain Otto Fulton recently gave a private demonstration of his apparatus for the projection of pictures in natural colours by the method of opaque projection. In order to overcome the great loss of light inherent in this method, two powerful electric lamps illuminate the prints. These are ordinary black and white photographs taken, as usual in three-colour work, through blue, green, and red screens, respectively, and the images are superposed on the screen. The remarkable part of the method is that the colour screens used in the projection are stated to be white, pale green, and pale orange, but we are assured that the rendering of the colours of the original was remarkably accurate. The method is stated to be applicable to kinematography.

THE expedition of the Egypt Exploration Fund which, under the leadership of Prof. Naville, is now excavating for the third season in succession at Abydos, in Upper Egypt, reports (in *The Times* of Monday, January 15) that interesting discoveries have been made in the great necropolis, including tombs dating from the pre-dynastic age to the Roman period. "Of the latter a magnificent example was found. It consisted of a vaulted chamber, some 20 feet in length, built of mud bricks, and originally almost hidden in the sand. The building of another similar tomb over it at a slightly later date had saved it from the plunderer. On its floor lay twelve heavy coffins of limestone, each with its carefully sealed cover. Within each lay the mummy, carefully and laboriously wrapped in its linen bandages, the blue and gold of its painted coverings as fresh as when laid in the tomb two thousand years ago." Other burials are also reported, especially one of

a woman of the twenty-second dynasty, who was found with all her ornaments, bead-necklaces, &c., including a ring of five scarabs, one of them bearing the name of Shishak, the conqueror of Jerusalem, and on her nose "still lay the small nose-ring of silver." Lastly, a burial of the twelfth dynasty may be mentioned; its period is known from an amethyst scarab, a stone rarely met with as used for scarabs after the time of the Middle Kingdom. These excavations have been carried on by Prof. Naville's assistants, Messrs. T. E. Peet, Whittemore, J. P. Droop, and the Hon. Robert Trefusis. On the arrival of Prof. Naville this month, the work of completing the excavation of the Osireion, the subterranean temple of King Meneptah (the supposed Pharaoh of the Exodus) will be taken in hand.

MR. A. ROSE, C.I.E., British Consul at Tengyueh, Yunnan, read a paper on the Chinese frontier of India before the Royal Geographical Society on Monday, January 15. The paper dealt mainly with the very interesting problems of political geography which have recently come into prominence in Asia, where China has of late years been active in increasing her influence on her southern and western frontiers. The lecturer dealt specially with that portion of the Chinese frontier which marches with that of Burmah, the region with which he was intimately acquainted, and described a hurried march to Hpimaw, close to the frontier. The frontier tribes were described and their characteristics discussed, while much interesting information was given concerning the systematic spread of Chinese influence over this border country in which suzerainty is claimed by China. An interesting collection of dresses and of metal and other objects made by these wild border tribes was also exhibited.

A SECOND contribution by Dr. C. K. Edmunds, president of Canton Christian College, on science among the Chinese, appears in the January issue of *The Popular Science Monthly*. Some intimate students of Chinese literature and life claim that in many cases Chinese philosophy has anticipated the doctrines of modern science. During the Sung dynasty, in the century 1020–1120 A.D., lived several famous Chinese philosophers, of whom Chu was the most distinguished, and it is in his writings that these references are found which it is claimed foresaw modern views. Dr. Edmunds thinks it may be admitted that Chinese philosophers entertained some general ideas concerning an all-pervading medium, that they had clear ideas on mechanical action and reaction, and very crude views concerning the transformation of energy, which vaguely suggest those held to-day. He sees no just grounds for believing that they held any ideas comparable with the modern vortex motion in the æther, of the conservation of energy, or of biological or cosmological evolution. As he points out, the method of modern science is its distinguishing characteristic, and this was almost completely lacking among the Chinese.

IN the summers of 1909 and 1910 Mr. Charles Rothschild had the good fortune to discover on trees near the Serpentine specimens of a minute fly of the psychodid group which proved to belong to a species previously unknown to science. This is described by the Rev. A. E. Eaton in the January number of *The Entomologist's Monthly Magazine* as *Telmatoscopus rothschildi*.

IN the administration reports for 1910–11, Dr. J. Pearson, director of the Columbo Museum, pays well-deserved testimony to the services rendered to that institution by his predecessor, Dr. Arthur Willey (now Strathcona professor of zoology at McGill University), pointing out that during his eight years' term of office the building was enlarged, the collection greatly increased, and *Spolia Zeylanica*, the museum journal, founded. During his own term of office Dr. Pearson is enabled to record continued progress in the museum, but he pleads for further extension of the building, and likewise for additional library funds.

ACCORDING to the January number of *The Museums Journal*, the experiment of giving illustrated explanations of the exhibits in certain sections of the Royal Scottish Museum on two evenings in each week to visitors has proved a decided success. The demonstrations are now held in the examination room of the University, which is sufficiently large to permit of the display of lantern illustrations of the objects in the collection, as well as of others which serve to throw further light on the subject of each demonstration. In the same issue an extract is reprinted, without comment, from a daily paper in which the writer alludes to musk-oxen, to say nothing of tigers, as Russian animals!

FOR some years past the Trivandrum Museum, Travancore, has issued only a brief summary of each year's work. It has, however, been decided that fuller reports are desirable, and the director, Colonel F. W. Dawson, has accordingly issued a combined report for the years 1904–9. During this period the museum appears to have made good progress, a special feature being the preparation of plaster casts of specimens that are difficult to prepare in other ways. So excellent are these casts (of which examples may be seen in the Natural History Museum, South Kensington) that Dr. Willey, while director of the Colombo Museum, paid a visit to Trivandrum in order to learn the technique of these castings. Another feature of the work of the museum is the number of cetaceans of various species which have been acquired and described during the period under review.

To No. 18 of the *Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg*, for 1911, Dr. N. V. Nasonov, director of the zoological museum of the academy, communicates a well-illustrated paper—unfortunately in Russian—on the mouflon and kindred species of wild sheep, the greater and more important part of the memoir being devoted to the forms commonly included under the title of Gmelin's sheep (*Ovis orientalis*). That species—then regarded as a race of the mouflon—was described in 1824 by Brandt and Ratzeburg, and stated to inhabit the "Ceraunian Mountains" of Persia, the Greek Islands, and Cyprus. As Persia is first mentioned, that country has generally been regarded as the type locality; but Dr. Nasonov accords this position to Cyprus, and therefore regards the Cyprian so-called *O. ophion* as the type of the species. The validity of this view will require careful consideration. In addition to the Cyprian sheep, *orientalis* is taken to include the Armenian *gmelini* and the Anatolian *anatolica* as local races. On the other hand, the sheep from the Lake Urmi district, originally described by Dr. A. Günther as *O. ophion urmiana*, is considered to represent a distinct species, with a local race (*erskinei*) from the Elburz Range, and a second (*isphahanica*) from the Ispahan district. Judging from the figures of the skulls and horns (for the text is incomprehensible to the writer of this note), Dr. Nasonov appears to rely largely on the direction of the horns in distinguishing *urmiana* from *orientalis*. In the former they extend far behind the occiput, while their tips do not descend much below the level of the teeth, whereas in the latter they curve downwards, so that their tips are far below the plane of the upper teeth. The local races seem, however, to show

some degree of gradation in these respects; but the forms included in *orientalis* probably have a smaller development of the throat-ruff. Whether these features are of specific value is doubtful. In his latest communication on the subject Mr. Lydekker regarded *erskinei* as equivalent to the typical race of *orientalis*.

MR. C. H. O'DONOGHUE contributes to the current number of the *Quarterly Journal of Microscopical Science* (vol. lvii., part ii.) an interesting memoir on the mammary glands of the Australian marsupial cat (Dasyurus). The gland arises as outgrowths from the follicles of certain hairs which appear on the rudiment of the teat, and these hairs, which subsequently disappear, are equal in number to the main milk ducts in the adult teat. The author also discusses the causes which contribute towards the hypertrophy of the mammary gland during pregnancy and at other times, and concludes that the stimulus to growth is not a nervous one, but is due to an internal secretion or hormone circulating in the blood. It has long been known that there is an intimate correlation between the presence of the corpora lutea in the ovary and the fixation of the fœtus to the uterine wall, and it is supposed that the corpora lutea are glandular bodies the secretion of which, conveyed by the blood, stimulates the wall of the uterus to undergo the necessary changes in preparation for the reception of the fœtus. Mr. O'Donoghue gives good reasons for believing that the secretion of the corpora lutea also stimulates the mammary glands, and thus causes their enlargement, although other factors are probably responsible for causing the actual secretion of milk. We note that Mr. O'Donoghue makes use of the German term "Anlage," where, as it appears to us, "rudiment" would be greatly preferable.

THE third volume of the Indian Forest Records begins with an important part prepared by Mr. R. S. Troup, in which the author examines statistical and other information regarding the teak forests of Burma. It is noted that the limits of natural teak forests, except to the east, lie within the province. The total area of teak forests cannot be computed, but with regard to the reserved forests, exceeding 25,000 square miles, rather less than one quarter is returned as teak-bearing (which implies about 6 per cent. of the growing stock). The greater part of the teak forests may be designated either as "upper mixed," occupying hilly country and characterised by the prevalence of bamboos, or as "lower mixed," on flat ground. In the former class distinction is drawn between dry forest, where *Dendrocalamus strictus* is a common bamboo, and moist forest, which often contains *Bambusa polymorpha* or *Cephalostachyum pergracile*. According to available figures, teak trees require 110 to 190 years to reach a girth of 7 feet, upon which basis the exploitable age has been fixed at 150 to 180 years.

Petermann's Mitteilungen for December, 1911, contains a map of the world to show the state of our knowledge regarding the relief of the earth's surface. Five grades are employed, both on land and sea areas, to classify the data according to their completeness. Over the oceans the number of soundings in a 1° square (2° beyond the 60th parallel) is used as the basis of classification, but on land the scale on which maps have been published is adopted on the assumption that the density of points of which the altitudes have been determined, and the accuracy of the results, are comparable with the scale on which maps are published. A close investigation of every land area to determine the density of determined altitudes and the accuracy of the determinations would be a long piece of work, but it is the only satisfactory way of arriving at the present state of our knowledge of the earth's relief.

MR. E. K. SUVOROF explored the Commander Islands in the summer of 1910, and his observations are described in the Izvestiya of the Russian Geographical Society (No. 6, 1911). The group consists of four islands, the well-known Bering and Copper Islands, and two small ones which, having no fresh water, are inhabited only by innumerable birds. Bering Island consists of two parts, a northern, low, and covered with tundra, and studded by a few hills not reaching 600 feet, and a southern, which is a chaotic mass of elevations in chains and groups attaining a height of 2200 feet, and is almost inaccessible except along the coast. Volcanic tuff is the prevailing formation. The northern tundra has been formed by the silting-up of lakes which were originally inlets from the sea, and have been cut off from it by upheaval of the land. In some places may be noticed two, or even three, clearly marked terraces. One of the lakes still in existence, the Sarannoie, is supposed by the natives to be of unfathomable depth, but Mr. Suvorof found its deepest hollow sounded only 57½ feet. Nor are the reports of its extraordinarily low temperature correct, for on July 4 the temperature fell from 54·3° F. at the surface to 50°. Copper Island has a more complicated geological structure. Tuff and tuff conglomerate certainly predominate, but dacite, basalt, augite, and andesite occur on the north-east coast. The line of coast is determined by a fault. The inhabitants of the islands, Aleuts, with an admixture of several other elements, keep a few cattle and pigs and catch salmon, cod, blue foxes, and sea-otters, the last almost exclusively at Copper Island.

AMONG the very useful summaries of the geology of British districts, prepared by specialists and published in the Proceedings of the Geologists' Association, should be mentioned those on "The Districts around Settle and Harrogate," by Prof. Percy F. Kendall (vol. xxii., 1911, p. 27); on "The District around St. David's, Pembrokeshire," by Mr. J. F. N. Green (*ibid.*, p. 121); on "The Neighbourhood of Fort William," by Mr. E. B. Bailey; on "The Neighbourhood of Broadford, Skye," by A. Harker; and on "The Geology of the Cuillin Range," by Mr. W. F. Gwinnell. The last three follow one another in part 4 of vol. xxii., pp. 179–214. The photographic illustrations and the sections in these papers make them additionally serviceable to teachers. In plate xi. the famous unconformity at the Arco Wood Quarry, Ribblesdale, is reproduced, and the view of Ingleborough (plate xii.) is one of the finest that we know. Prof. Kendall publishes (p. 37) his conclusion that the Yoredale and Pendleside series are really contemporaneous, a matter on which much more is certain to be written. Mr. Bailey's paper includes a description of the "cauldron-subsidence" of Glencoe and of the igneous history of Ben Nevis, where sinking is also recognised, and where it accounts for the preservation of the summit andesites in an encircling ring of granite.

AT the meeting of the Vienna Academy of Sciences on November 30, 1911, Prof. J. Hann submitted a work entitled "Results of Dr. E. Glaser's Meteorological Observations at Sana (Yemen)." The observations were made between January and October, 1883, only, but as no complete data for the interior of Arabia were previously available, the present carefully made series is of considerable interest. By comparison with observations for corresponding months at stations on the adjacent coast, and the use of interpolation formulæ, Dr. Hann was able to deduce very approximate monthly and yearly values of

pressure and temperature. The regularity of other phenomena also made it possible to obtain mean values for them also, rainfall being the most uncertain. The mean pressure (altitude 2370 metres) is:—winter, 577·5 mm.; summer, 573·3; year, 575·5; temperature for same periods, 14·2°, 20·6°, 17·5° C. Mean annual humidity, 50 per cent.; rainfall, 452 mm. The daily range of temperature is very large, especially in winter. The mean minimum in winter is about 4·8°, mean temperature at 2h. p.m., 24°; in summer, 13·5° and 25·8° respectively. Once in February −0·4° was recorded (which is not unusual on the plateaux); the absolute maxima at 2h. p.m. often exceed 30°, and a reading of 33° has been recorded by the maximum thermometer. In 1883 the rainy period lasted from March to August, with a complete break in June (which was abnormal). During thunderstorms rain and hail showers are often heavy (on July 23, 52 mm.). From May to October north and north-east winds, January to April south winds, were most prevalent; the latter are mostly light morning breezes; all the stronger winds are northerly, and sometimes reach storm force.

The Scientific American for December 23, 1911, contains an illustrated one-page article on Sir Joseph Thomson, by Dr. P. Phillips. It gives a short sketch of his education, and describes how Sir Joseph, after his appointment as professor of experimental physics at Cambridge when a "mere boy," gradually built up the present school of research and made the Cavendish Laboratory famous throughout the world. A clear picture is drawn of the great master amongst his students; and at this stage the author cannot keep up the formal references to "Sir J. J. Thomson," but lapses into the old affectionate "J. J." The portrait which illustrates the article shows Sir Joseph in a very characteristic attitude.

The Central for December, 1911, has an interesting article on a new aluminium industry, by Mr. A. V. Hussey. It describes the methods used in the manufacture of large vats and tanks from sheet aluminium. The joints, which are generally butt joints, are welded by means of an oxy-hydrogen blow-pipe, which melts the metal at the joint, while a special flux dissolves the oxide formed and allows the two edges of metal to run together. When the joint has been trimmed and hammered it is as smooth as the rest of the sheet, and under test proves as strong as the unworked parts. The development of the industry has apparently been in the hands of old students of the City and Guilds College throughout. The editors appeal to old students for their views as to the values of individual portions of the three years' course at the college. These may be of special value, as it is not often that those taught get an opportunity of expressing themselves. We trust the anxiety expressed by the editors as to the future of the Old Students' Association, owing to the numerous changes now taking place at South Kensington, will prove to be unfounded.

OPTICAL wedges have been in use for a long time, but the graduated tint was always narrow in proportion to its length. It is only about eighteen months ago that Dr. Goldberg suggested the use of "wedge-screens," and showed how they could be produced by casting pigmented gelatine in a mould of two sheets of glass that touch at one edge, and are slightly separated at the opposite edge. Wedge-screens are now made of great accuracy by Messrs. Ilford, Ltd., and at a recent meeting of the Royal Photographic Society Mr. Renwick described some of their uses. The essential feature of the wedge-screen is that it is wide, that is, square or approximately square, and this allows of another plate upon which, for example, a graduated tint has been produced for testing purposes, being rotated upon the wedge-screen. If the gradation of the plate is exactly the same as that of the screen, and they are brought face to face in reversed positions, the two together give a uniform tint. Then, knowing the values of the screen, the gradation of the plate is known also. But if the two gradations are not equal, by isolating a strip and rotating the one upon the other it is possible to get the visible strip of equal density throughout its length; and Mr. Renwick showed the exact relationship between the angle of rotation and the comparative steepness of gradation of the screen and the plate, whether the plate is steeper or less steep than the screen. The one screen plate, therefore, permits of the measurement of the steepness of gradation of any plate, the screen with its known values being the standard, without the use of any photometric instrument, except perhaps in a secondary sense and of the simplest description, to determine the equality of the density of the observed strip.

IN connection with the application of photography to the detection of adulteration, the current (January) number of *The World's Work* contains some interesting reproductions of photomicrographs, by Mr. Ernest Marriage. Of these, the following may be specially mentioned:—pure apple jam; "improved" strawberry and gooseberry; "improved" raspberry and currant; pure blackcurrant jam; blackcurrant "improved" with fruit jelly. In all these samples of so-called "improved" jams the characteristic apple-cells are clearly discernible. The photographs are published in illustration of an article by "Home Counties" entitled "Unsophisticated Jam."

THE Bulletin of the St. Petersburg Academy of Sciences, part xv. of 1911, contains an important paper, by Prof. Walden, of Riga, on formamide as an ionising solvent. This solvent has the property of imitating in a remarkable degree the physical characteristics and constants of water. In the present paper its behaviour as a solvent in cryoscopic measurements and the electrical conductivity of its solutions are described. It is shown that when binary salts are used as solutes, solutions are obtained for which the coefficient of ionisation may be even greater than in water. Moreover, the cryoscopic and the electrical measurements agree in giving concordant figures for the coefficient of ionisation over a range of dilutions from 5 to 100 litres per gram-molecule. Strong organic acids, such as tribromoacetic acid, do not, however, become ionised to any marked extent when dissolved in formamide. It was found that starch dissolved in formamide gave a molecular weight $M=645$, corresponding with the formula $(C_6H_{10}O_5)_4$, and that its specific rotatory power was $+189°$. Casein gave a molecular weight $M=400$, and specific rotatory power $-106°$ to $-88°$.

THE *Revue générale des Sciences* of December 15, 1911, contains an article by M. Lamotte on the recent work of the Cryogenic Laboratory of Leyden. An account is there given of the methods used in liquefying helium on an extensive scale, and two diagrams are reproduced to show the arrangement of the apparatus. The work recently carried out with the help of liquid hydrogen and liquid helium includes:—(1) a determination of the critical pressure of neon (29 atmospheres) and of its pressure at the triple point (35 centimetres); (2) an investigation of the constants of argon; (3) measurements of resistance of metals at low temperatures, whereby it has been shown that the resistance of gold and of mercury falls almost

to zero at 3° A.; at this temperature the resistance of mercury is less than one ten-millionth of its value at 0°, whilst at 1·5° A. it is still smaller; (4) investigations of magnetic susceptibility and thermoelectric force. Attention may also be directed to two articles on the fixation of atmospheric nitrogen in the same journal of November 30 and December 15, 1911; these are accompanied by a series of interesting and unfamiliar illustrations.

THE first number of *The Chemical World* is a very readable production. The new journal is a monthly periodical published by Messrs. J. and A. Churchill; its aim is "to present to those interested in the many branches of chemistry an account of progress in both theory and practice." Written from this viewpoint, a number of short articles deal with various topics of chemical interest, and form the chief feature of the magazine. Among these are "The Detection of Mydriatic Alkaloids," by Mr. F. H. Carr, discussing a problem which arose recently in a notable murder trial; "The Chemical Characterisation of Soils," a useful contribution by Dr. E. J. Russell; "The Recent Progress of Organic Chemistry," in which Dr. A. Clayton describes Knorr's isolation of the ketone and enol forms from ethyl aceto-acetate; and a summary of "Metallurgical Progress in 1911," by Mr. G. T. Holloway. An illustrated article on the chemical department of the Royal College of Science, with a portrait of Sir Edward Thorpe, is the first of a series of similar accounts which will deal with the chemical establishments of modern universities and technical colleges. Other serial contributions commenced are one by Mr. E. Hatschek on "The Physics and Chemistry of Colloids," and one on "Chemical Research" by the editor. Sections are also devoted to physical chemistry, chemical engineering, and chemical industries, whilst patents and commercial matters are not forgotten. Thus the new venture appeals to many interests, and, judging by the first issue, it deserves a cordial welcome.

IN a paper on the direct experimental determination of the stresses in the steel and in the concrete of reinforced-concrete columns, read before the Institution of Civil Engineers on January 9 by Mr. W. C. Popplewell, is described a method of measuring the simultaneous shortening of the steel bars and of the concrete. Martens extensometers were used; for the steel these were applied to the ends of pairs of pins projecting from the reinforcing bars through holes in the concrete; for the concrete the extensometers were applied to the surface as near as possible to the steel. The elastic moduli for the steel and the concrete were thus found to be 30,200,000 and 1,535,000 lb. per square inch respectively. A further set of experiments carried out to determine the intensity of the frictional grip of the concrete on the steel resulted in values ranging from 300 to 600 lb. per square inch of bar surface, to cause slipping. When all the effects of eccentric loading have been eliminated from the results of the tests on columns, there is no evidence to indicate that slipping took place. In columns of this kind, made up with plain smooth bars, the two materials behave like one, so far as their strain effects are concerned.

AN article on propeller erosion in *Engineering* for January 12 gives an account of a research conducted by Dr. O. Silberrad, of Buckhurst Hill, Essex, in conjunction with the Manganese Bronze and Brass Company, Ltd. Propellers driven by comparatively slow-running reciprocating engines are free from erosion when constructed of manganese bronze. When, however, the same alloy was used for turbine-driven propellers erosion reappeared, and often of a very serious character. In the case of the *Mauretania* and *Lusitania*, had no remedy been found the propellers would have required replacing every few months at a cost of some thousands of pounds. Each propeller weighed about 20 tons, and the cost ranges from 130*l.* to 180*l.* per ton. The erosion seems to have been due to the eutectic being washed away, the mixed crystals constituting the main mass of the alloy being practically unaffected. The research has been successful in the discovery of an alloy which is now in actual service on the *Mauretania*, and has proved itself practically inerodible. The new alloy is patented conjointly by Mr. P. R. Parsons, of the Manganese Bronze and Brass Company, and Dr. Silberrad, and is called Parsons' New Turbadium. It has a tensile strength of 38 to 40 tons per square inch, an elastic limit of 18 to 19 tons per square inch, and an elongation of 15 per cent. on 2 inches. In the erosion tests it showed an endurance about five times that of ordinary high-tension bronze, and this result has been confirmed in actual service. We understand that the British Admiralty has approved its use for the propellers of war vessels fitted with turbine engines.

THE thirty-ninth issue of "Willing's Press Guide," that for 1912, has, as usual, been carefully revised, and well maintains its character as a handy and easily consulted index to the Press of the United Kingdom and to the principal colonial and foreign periodicals. A variety of general information adds to the value of the volume.

A COPY of a convenient monthly weather chart for daily observation has been received from Messrs. George Philip and Son, Ltd. Provision is made for a record of readings of the wet and dry-bulb thermometers, maximum and minimum thermometers, rain-gauge, and barometer. Space is also allotted to wind and weather observations. The price of each sheet is one penny.

A NEW and enlarged edition of "Soap-bubbles: their Colours and the Forces which Mould them," by Prof. C. V. Boys, F.R.S., has been published by the Society for Promoting Christian Knowledge. The several new and original sections which the present issue contains provide, like the lectures Prof. Boys has been giving lately to the Royal Society of Arts juvenile audiences, still further evidence of the author's genius for experimenting and his talent for clear and interesting exposition. The price of the new edition is 3*s.*

SIR EDWARD THORPE'S well-known "Dictionary of Applied Chemistry" is being revised and enlarged, and Messrs. Longmans and Co. announce that the new edition will be issued in five volumes. The first volume will be ready in a few days, and vol. ii. early in the summer. It is hoped that the work will be completed within two years. Messrs. Longmans announce also that the work on "Surgery," by Sir W. Watson Cheyne and Mr. F. F. Burghard, has been entirely revised and rewritten with the assistance of Mr. T. P. Legg and Mr. Arthur Edmunds. The first volume will be issued before the end of the present month, and vol. ii. in April next.

OUR ASTRONOMICAL COLUMN.

POSSIBLE CHANGES IN SATURN'S RINGS.—At the meeting of the Royal Astronomical Society, held on Friday last, it was announced that a telegram had been received, by Sir David Gill, from Prof. Todd, in which he said:—"Near the extremities of the major axes of the bright outer ring of Saturn, with the aid of a powerful telescope, I have

observed a certain sparkling flocculence which I interpreted to be a dissipation of the ring."

Commenting on this message, the Rev. T. E. R. Phillips stated that he had observed Saturn the previous night, but had failed to note any extraordinary feature such as was described in Prof. Todd's message; it was, however, possible that the affected section of the ring was not then in view. He also added that, according to the accepted view of the constitution of the rings, disturbances of some kind were likely to occur from time to time, and that these might be revealed by irregularities in the shape of the shadow of the ball on the rings. At the previous apparition he had seen such irregularities, but recently he had thought the shadow perfectly uniform. Other observers, who had been able to see the Encke's division easily, had also noted nothing irregular or unusual.

A *Daily Mail* inquiry at Greenwich elicited the suggestion that the phenomenon may have been produced by the collision of two of the particles forming the ring, the heat generated by the impact possibly raising the particles to incandescence. Owing to the comparatively large separation of the particles and their uniform motion, such collisions would not be of frequent occurrence.

MARS.—Numerous observations made at the Sétif Observatory are recorded in No. 4545 of the *Astronomische Nachrichten*. Among other things, the disappearance of the south polar spot since December 13, 1911, is noted, and it is remarked that its position was occupied by a large, well-marked area having the same hue as the southern "islands." Special attention has been paid recently to the study of Libya, which M. Jarry-Desloges considers important in the study of abnormal clear places on Mars. He gives details of observations showing changes in the brightness and tint of Libya during the period December 14–23, 1911. A telegram received on December 28, 1911, states that the Thyle region had been abnormal since December 18, being whitish with brilliant spots. The Styx was observed double, and M. Tyrrhenum and Syrtis Minor were always vague. Telegraphing on December 30, the same observer stated that considerable changes had taken place in the north polar cap during the preceding twenty-four hours. An important white band was seen between Propontis and Palus Mæotis, and M. Tyrrhenum was extended over Eridania. On January 4 M. Jarry-Desloges announced the reappearance of the south polar cap.

A NEW VARIABLE OR NOVA, 87, 1911, PERSEI.—Mr. C. R. D'Esterre, in a note appearing in No. 4545 of the *Astronomische Nachrichten*, describes his observations of an object in Perseus which would appear to be a new variable star or a nova. On a photograph taken on November 13, 1911, when the object was at its maximum brightness, about mag. 11–12, the image of the newly discovered variable overlapped the images of two neighbouring stars, whereas it is not shown at all on photographs showing objects much fainter than the eleventh magnitude taken with the same instruments during August, 1911. The position of the object in question is 2h. om. 13·1s., +56° 29·8′ for 1855·0, and 2h. 3m. 16·3s., +56° 42·8′ for 1900·0.

THE LIGHT OF COMETS 1911*b* AND 1911*c*.—In a note appearing in No. 4545 of the *Astronomische Nachrichten* M. Orlow discusses the varying brightness of Kiess's (1911*b*) and Brooks's (1911*c*) comets. Admitting that the brightness is proportional to Δ^{-2}, he seeks for the different comets the exponent of the quantity r. For Brooks's comet, from twenty-three observations made during August 27 to October 13, he finds that $1/\Delta^2 r^{3\cdot2}$ gives the nearest approximation to the observed curve, H_0, the mean brightness, being 5·1.

From twelve observations published by Dr. Holetschek he finds that $H_0=7\cdot2$ and $r^{-3\cdot4}$ are the values which best fit the brightness of Kiess's comet. For two other comets, 1910*a* and 1908*c*, he derives the values $H_0=5\cdot4$, $r^{-4\cdot0}$, and $H_0=4\cdot3$, $r^{3\cdot5}$, respectively.

THE SOLAR CONSTANT.—In No. 5, vol. xxxiv., of *The Astrophysical Journal* Prof. Very has an article on the need of adjustment of the data of terrestrial meteorology and of solar radiation, and on the best value of the solar constant. In it he criticises the recent work of Abbot and Fowle in the determination of the solar constant, and argues that while their methods purport to follow Langley's methods, they have abandoned the essential principle of the latter, and more nearly approximate to Pouillet's. Prof. Very argues that too low a value has been assigned to the effective depletion of the incident solar rays, and consequently too low a value has been obtained for the solar constant. Whereas the value of approximately 2 calories is given in the second volume of the Annals of the Astrophysical Observatory of the Smithsonian Institution, Prof. Very finds evidence on every hand that the value should be greater than 3 but less than 4 calories.

THE SURVEY OF INDIA.[1]

THE report of the operations of the Survey of India during the year 1909–10[1] has just been issued by Colonel S. G. Burrard, R.E., F.R.S., the Officiating Surveyor-General. During the year the new scheme of reorganisation which had been approved was brought into operation, and in it provision is made for three topographical circles, the northern, southern, and eastern, each under a superintendent. Four topographical survey parties are allotted to each, and there are six trigonometrical parties under the direction of the Superintendent of Trigonometrical Surveys. Details are given of the topographical work executed in each of the three circles, and maps show the distribution of the areas surveyed and the portions which have been surveyed since October, 1905. The forest surveys were carried out in almost every case by the particular topographical parties in whose spheres of work the forests lay, and were mainly on the scale of 2 inches to 1 mile.

The principal triangulation was continued in the North Baluchistan series, the Kashmir series, and in the Upper Irrawaddy series, a total of thirty-five stations being observed from, and thirty-nine triangles being completed, the average angular errors being 0·303″, 0·591″, and 0·381″ respectively in the three areas of work. A series of comparisons was carried out to test the accuracy of mercurial barometers, aneroid barometers, and hypsometers as height-measuring instruments. The results showed that the aneroid barometers differed greatly from one another and from the mercurial barometers. The latter gave heights in defect, and the hypsometers gave heights considerably in excess of those obtained by triangulation; the excess at 16,000 feet being as much as 600 feet. Astronomical latitudes were observed in Oudh, and pendulum operations were extended to the east and north-east of the area investigated in the season 1908–9 in Central India, twelve stations having been visited this year in the tract situated between lats. 21° and 26° N., and longs. 79° and 83° E. The magnetic survey and the tidal operations were continued.

At Dehra Dun the base-line observatory was commenced in 1909, and its construction is now in hand. A complete apparatus of wires has been purchased to replace the old compensation bars, and approximate sites for base lines in Burma and Baluchistan have been selected. The simultaneous reduction of the levelling was completed during the summer of 1910; all closing errors of circuits were eliminated, and the level net was connected to sea-level at nine different points; orthometric corrections were applied, and adjusted values of all bench-marks fixed between 1858 and 1909 were obtained. The results are published as vol. xix. of the 'Account of the Operation of the Great Trigonometrical Survey of India," and the publication of this volume marks the close of the first half-century of levelling work in India, thus providing a scientific and consistent basis for the levelling operations of the future.

H. G. L.

[1] The General Report on the Operations of the Survey of India during the Survey Year 1909–10. Prepared under the direction of Colonel S. G. Burrard, R.E., F.R.S., Officiating Surveyor-General of India. (Calcutta, 1911.) Price 2 rupees or 3s.

THE SAND-DUNES OF NEW ZEALAND.[1]

SAND-DUNES originating from the shore occupy an area of 290,000 acres in the North Island and 24,000 acres in the South Island of New Zealand. Protection against inroads of the sea is not a pressing matter in New Zealand, but protection of fertile lands from burial by marching dunes is, and it is for the latter purpose that the dunes have to be fixed. With this object in view, the Sand-drift Act of 1908 was passed. By it the Minister of Lands is empowered to cause operations to be undertaken for controlling sand-drift within a proclaimed area, the cost being apportioned among the owners of land within that area. The order is subject to appeal to the local magistrate, the final decision resting with a board consisting of the magistrate and two assessors, one appointed by the Government, the other by the local authority.

Photo. [*L. Cockayne.*

FIG. 1.—Interior of Plantation on Dunes, New Brighton, chiefly *Pinus insignis*.

The rainfall of New Zealand being ample, it is only necessary for the first stage of reclamation to select a plant which can withstand the impact of driving sand and adjust itself to a rising surface. The best of all is the marram grass (*Ammophila arenaria*). Practical directions for planting are given in the report. This plant has little value for grazing, and farmers are warned that it is impossible to fix the dunes by means of any plant valuable for pasture. When the dune-tract is so fixed by marram grass that the sand no longer drifts, the grass dies off in patches. Here pasture grasses may be sown, *e.g.* Yorkshire fog and clovers, to be replaced later by more compact turf-formers. Thus the whole dune-tract is gradually converted to pasture. Great care is necessary to plant uniformly, avoiding the formation of trough-like wind-channels; and "wounds" in the marram or turf must be attended to at once.

Photo.] [*L. Cockayne.*

FIG. 2.—Successful planting of Marram Grass in a Wind Channel. Plants rather too far apart. Cliff-dunes south of Manukau Harbour.

The proper use of dune-tracts is, however, in Dr. Cockayne's opinion, for the growth of valuable trees. *Pinus insignis* is stated to be the most suitable. These should be planted from 2½ to 3½ feet apart. In Germany, generally speaking, marram grass is only used for the foredune; while immediately in its lee the planting of trees takes place without any preliminary fixing by sand-binding plants, the sand being, however, partially fixed by a network of sand-fences consisting of upright sticks. In France the area behind the foredune has been converted to forest, not by planting, but by sowing.

Measurements of the rate of march of a dune are always useful. The following case is given in the report. The position of a wandering dune in the Kaipara district, Auckland, was determined in 1866. By the end of 1910 it had advanced 132 yards, *i.e.* 9 feet per annum.

Dr. Cockayne's valuable report contains a list of seventy-four papers bearing upon the subject of the sand-dunes of New Zealand. VAUGHAN CORNISH.

[1] Report on the Dune-areas of New Zealand: their Geology, Botany, and Reclamation. By Dr. L. Cockayne. (Wellington, 1911.)

BREWING AND MODERN SCIENCE.[1]

THE industry of brewing has earned unenviable notoriety as affording a subject for every possible kind of controversy: it has been also the most favoured field for the application of modern science. The brewer, faced by competition and by repeated increases of taxation, has sought the help of science in order to make the best possible use of his materials; the result has been in every way a complete justification of his action.

The industry has been more than fortunate in the men it attracted in its early days—Griess, O'Sullivan, Horace and Adrian Brown in this country, to name but a few, have been all men of science of the very first rank. Moreover, the problems of brewing have been so fascinating in themselves, and so intimately bound up with the study of vital change, that they have attracted the interest of a host of other workers not connected with the industry.

In consequence, however much brewing may owe to science, it may be claimed that the advance of modern science has received material assistance from investigations connected with brewing. There is probably no other industry which, in this respect, can exhibit as good a record.

The brewer's task—to make a fermented liquor from malt, hops and yeast—does not appear at first sight to present such complications, but on closer examination it will be found that problems, often of the most vexed nature, are experienced both in the choice of the barley, in the manner of malting it, and in the methods of mashing and fermenting the liquor to the best advantage.

Any comprehensive review of the achievements of science in brewing during the last forty years is impossible within reasonable limits: it must suffice to indicate a few instances in which the progress has been most striking. The examples selected by Prof. Brown serve particularly to show how diversified in character are the problems with which the industry, in its successive operations, is faced.

Barley.

It is characteristic of many of our industries, and brewing offers no exception, that there is often a lack of that full sympathy which might be expected to exist between the producer of the raw material and its user. This is so often the case when agricultural interests are concerned, the farmer preferring, for example, to grow weak wheats rather than the stronger wheats in favour with the miller. In the case of brewing, the estrangement is due to a variety of causes, all tending, unfortunately, to diminish the consumption and lower the value of home-grown barley; most of these are beyond the brewers' control.

It is tempting to digress from the subject covered by the title of this article and reflect on the advantages of beer made entirely from malt and hops. There is a widespread opinion that the quality of English beer is not what it was, though it is equally true that the present article is in every way wholesome and suited to the public taste; indeed, if this were not the case, its production would soon cease to be possible commercially.

Before the abolition of the malt tax in 1880 the number of varieties of barley which the brewer could use with advantage was comparatively small. Since this date any suitable barley can be malted, and much has been done to put the knowledge of the subject on a scientific basis by the work of Beavan, first published so recently as 1900.

All barleys may be classified into two broad groups from the position and character of the flowers: these are six-rowed barleys and two-rowed. In addition, each group may have short and broad or narrow and long heads, making in all four distinct classes. These are well shown in Figs. 1 and 2.

In this country two-rowed barleys are the special consideration of the farmer. "Chevalier" barley represents the long, narrow-eared type, and "Goldthorpe" the short, wide-eared kind. The widest difference of opinion exists about their respective merits for malting and brewing. At present the evidence is in favour of Chevalier for the production of the higher qualities of ale, in spite of which, in many parts of the country, the culture of Goldthorpe barley is displacing that of Chevalier.

[1] Royal Society of Arts Cantor Lectures by Prof. Adrian J. Brown, F.R.S.

An altogether model series of investigations to determine the yield and money value of different varieties of barley has been carried on for six years by the Irish Department of Agriculture, assisted by Messrs. Guinness. The yield of the crop per acre for each of the varieties tested was determined under strictly practical conditions, and its commercial value ascertained on the market. From these data the value per acre was determined for each variety. Archer, a type of Chevalier, proved to be the best barley, being superior and more profitable to grow in every case. Goldthorpe was the best of the wide-eared barleys, but from the farmer's point of view it always gave poorer results than Archer. This conclusion applies primarily to Ireland, but probably it is equally true of English conditions. Another point brought out by the experiments was the importance of using pure seed; indeed, it is claimed that an increase of yield of six bushels per acre, and an increase in value of 200,000*l.*, would be effected in Ireland if pure selected Archer were substituted for the present varieties of barley sown.

B. A.

FIG. 1.—Six-rowed Barley. *A*, Wide-eared, with short joints (*H. hexastichum*). *B*, Narrow-eared, with long joints (*H. vulgare*).

The market values barley by empirical methods, based on such characteristics as the character of the skin of the grain, its size and shape, colour and relative hardness, together with other factors comprehended under the term "maturation." It is of interest that the scientific investigations of Beavan entirely uphold these methods of valuation, and enable them to be controlled more exactly in the laboratory.

The six-rowed barleys are obtained from countries possessing a warmer and more sunny climate than our own. Many of them are very heavy croppers, and possess valuable characteristics; there is obviously a considerable field open for the scientific plant-breeder to adapt them to English conditions.

B. A.

FIG. 2.—Two-rowed Barley. *A*, Wide-eared, with short joints (*H. zeocriton*, Goldthorpe). *B*, Narrow-eared, with long joints (*H. distichum*, Chevalier).

Malting.

The process of malting involves the germination of the barley grain up to the stage when the starch begins to be attacked; further action is then stopped by drying the malt. Although probably the germination changes of the barley corn have been studied more thoroughly than those of any other seed, our understanding of them is but of the slightest, and much requires to be done before malting is placed on a scientific basis.

The food reserve of most seeds is directly associated with the germ, but in cereal seeds this is not the case, the food

reserve being utilised through the agency of special physiological processes. The young plant may be dissected out from the endosperm without injury; a portion of it, called the scutellum, lies in contact with the endosperm, and feeds the germ from it (Fig. 3). As Fig. 4 shows, the endosperm is composed of two very different types of cells. The inner larger portion consists of thin-walled starch cells surrounded by the thick-walled aleurone cells without starch granules. When moistened, the dry barley corn absorbs water, swelling to the extent of 50 per cent. The characteristic re-entering ventral furrow (Fig. 5) allows of expansion, and so prevents rupture of the seed coverings. Internally, the cell walls nearest to the scutellum swell and disintegrate, and this action slowly spreads through the endosperm. Within about ten days the cell walls throughout the whole length of the corn are modified. The endosperm, in consequence, becomes soft and mealy instead of hard, and it can be broken and rubbed between the fingers. This stage of mealiness is that desired by the maltster. At the same time, the starch granules within the cells begin to be attacked; but this action is at first very slow, and only very little has been acted on when change is arrested by drying the malt.

FIG. 3.—Longitudinal Section of the Germ End of a Barley Corn (Highly Magnified). "Plum," plumule; "rad," radicle; "scut," scutellum; "ab ep," absorptive epithelial layer. (After Holzner.)

Brown and Morris found that the scutellum of the growing embryo secretes two enzymes, cytase and diastase, which bring about the changes described, whereas the endosperm is inert and without life. Later experiments by Brown and Escombe confirmed the contention of Haberlandt that the cells of the aleurone layer also secrete the same enzymes.

FIG. 4.—Section of Portion of Endosperm of a Barley Corn (Highly Magnified). *A*, Coverings of the corn. *B*, Aleurone cells containing no starch. *C*, Thin-walled starch-containing cells comprising the greater part of the endosperm. The starch granules are visible lying embedded in the remains of the cell proto plasms.

At various stages of the malting process the nitrogenous compounds originally present in the endosperm migrate to the embryo. These changes are due to the action of two other enzymes, a peptase and a tryptase. Probably these originate in the same parts of the corn as cytase, but direct evidence on this point is still wanting.

Barley and indeed all other seeds are specially protected by their coverings to prevent loss of the stored-up food material by diffusion. The testa, or inner thin skin of barley, constitutes a very remarkable semi-permeable membrane, allowing water to pass through, but preventing the passage out of the cell of the soluble carbohydrates and nitrogenous materials, or into the cell of such substances as mineral acids and salts. Still more remarkable is the power of selective permeability displayed by the skin: it allows such substances as mercuric chloride, acetic acid, acetone, ethyl acetate, and a few others to pass through, whilst keeping all other materials out. The elucidation of this peculiar behaviour is leading to results of most fundamental significance in connection with plant chemistry.

Mashing.

Having transformed the barley corn into a material full of diastase and other enzymes, it is the brewer's next care to cause further digestion to take place inside his vessels, his object being to transform the starch into soluble constituents. Much depends in practice on the way in which this operation is effected; the composition of the water, the state of division of the ground malt, and the temperature and duration of the process are all factors of prime importance. For the moment, however, we are only concerned with the nature of the transformations.

It is not yet forty years since O'Sullivan rediscovered maltose, and showed that this sugar, and not glucose, is formed from starch by the action of diastase. The new field opened up by this discovery attracted numerous investigators, but, notwithstanding their labours, the essential points are still in dispute: the constitution of the starch molecule and the manner of its breakdown are still far from being settled. The question is too complicated for discussion here other than from its more technical aspect.

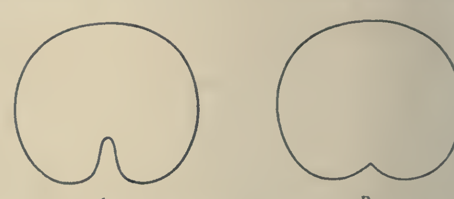

FIG. 5.—Diagram of Transverse Sections of Dry and Steeped Barley Corns. *A*, Dry corn. *B*, Steeped corn.

Brown and Morris have shown that among the products of a starch conversion performed at temperatures much the same as the brewer chooses in practice, are certain unfermentable maltodextrins. If the products from the starch consisted of maltose and stable dextrins only, the maltose would be entirely fermented in the brewery, and the beer obtained would be highly alcoholic and very thin in palate flavour. More important still, it would contain no carbohydrate material suitable for undergoing the secondary fermentation changes in the cask or bottle. Such material is supplied by the maltodextrins, which, though not fermentable during the primary fermentation, are slowly fermented by the secondary yeast forms which develop in beer when in cask or bottle, and give to good beer its characteristic qualities.

Fermentation.

Science has undoubtedly made very great strides in the elucidation of the fermentation process. Pasteur's famous investigations, in which he demonstrated the existence of anærobic life, led him to regard yeast as an organism endowed with two modes of life. When air was present it lived the life of an ordinary fungus and exhibited the usual actions of cell life; in the absence of air it took on the new properties of a ferment, and attacked sugar. This view persisted for many years, until Adrian Brown showed that, in malt wort, yeast cells increase until a definite number are present in a given volume; they then cease reproducing. This property of yeast is independent of the food supply, and makes it possible to work with a constant number of yeast cells. Under these conditions, it was found that oxygen, far from arresting the fermentative

power of yeast, as Pasteur supposed, actually tended to stimulate it.

Undoubtedly the most striking advance in connection with fermentation is Buchner's famous discovery that the direct cause of the fermentative power of yeast is an enzyme present in the cell. This at once destroyed all theories connecting fermentative power with the vital activity of the cell. The enzyme has been termed zymase, and its behaviour, which in many respects differs from that of other enzymes, has been studied very fully both by Buchner himself and also by Harden, whose results are of a very remarkable character.

When yeast juice, which contains active zymase, is filtered through a Chamberland gelatine filter, it is separated into two portions, one of which remains on the filter, whilst the other passes through. Apart, neither portion has any fermentative power; when united they ferment sugar. The filtrate still retains the power of activating the residue after it has been boiled; it has been named the co-enzyme. The part retained on the filter is destroyed by boiling; it is considered to be the enzyme.

Further experiments showed that dilute solutions of sodium or potassium phosphate have a marked stimulating effect on the activity of zymase, and proof has been afforded that a compound of sugar and phosphoric acid is formed when such addition is made. At the same time, a part of the sugar is decomposed to alcohol and carbon dioxide. An enzyme, appropriately named hexosephosphatase, is present in yeast juice, and serves to break down the compound of sugar and phosphate into its components.

Such facts as these have introduced altogether new conceptions into the knowledge of enzymes.

Without going into greater detail in so complex a subject, Dr. Harden's explanation of the fermentation process may be summed up somewhat as follows.

Enzyme and co-enzyme act in unison on a mixture of hexose sugar and phosphate; one half of the sugar is decomposed into alcohol and carbon dioxide, and the other half combines with the phosphate, forming hexosephosphate. The phosphate is thus for the time being put out of action, but the hexosephosphatase enzyme comes into work and resolves it into free phosphate and free sugar, when the cycle of changes begins anew. The speed of fermentation is regulated by the activity of the hexosephosphatase. Dr. Harden has calculated that with ordinary brewer's yeast at 25° C. the whole of the phosphorus of its cell goes through this cycle twice in every five minutes!

It is well known that, besides ordinary ethyl alcohol, small quantities of other higher alcohols are formed during fermentation, particularly under the working conditions of a distillery. The explanation of the formation of these "fusel oil" constituents has been long outstanding, but quite recently Ehrlich has proved beyond doubt that they arise from the action of yeast on the amino-acids ordinarily present in fermentable liquors. These alcohols are physiologically of great importance as stimulants and excitants of protoplasmic activity. Their presence, even in the minutest quantity, has considerable bearing on questions of flavour, so that technically the proper understanding of their mode of formation is a matter of great importance. Ehrlich's researches have gone far in this direction, and their application in practice is bound to lead to valuable results. It is not improbable that many of the subtle flavouring materials met with in plants may originate from amino-acids in the same manner.

Much has been done in studying the influence of traces of other substances on yeast, since the final character of the beer depends to a large extent on the fermentation being normal. As showing how sensitive the living cell is to stimulus, the effect of zinc on the growth of the mould fungus, *Aspergillus niger*, may be cited. Almost inconceivably small amounts of this element—a dilution of 1 part in 50 millions—are capable of exercising a noticeable effect in favouring growth. Copper in like dilution is known to have a poisonous effect on bacteria, and it is evident that the brewer must use the greatest care in the selection of his vessels.

In addition to the thirteen elements which are generally stated to be essential to plant life, many others are found in plants in very small quantities. The tendency has been, for the most part, to regard these as accidentally acquired, and not essential. Latterly the point of view is changing, and there is evidence that some at least of the elements present in minimal quantities play a very important part.

Sufficient has been said to indicate how closely science and brewing are connected, and how many problems still await solution.

EDUCATIONAL CONFERENCES CONSIDERED IN RELATION TO SCIENCE IN PUBLIC SCHOOLS.

I.

THE end of the second week in January marks the close of a series of conferences which are annually attended by teachers. The majority of these conferences are concerned, in the main, with topics which have only a remote connection with the subjects usually connoted by "science." An exception to this statement must, of course, be made in the case of the proceedings of the Association of Science Masters in Public Schools, which have a strong and beneficial influence on the early training of men who may be expected to take leading positions, not only in the university, but in the country generally. It is owing in part to the realisation of this influence, in part to the sensitiveness and ready response to stimuli of the audience, in part to good management of the society, that the association has been able to secure, year by year, an address from a man of real eminence, and this time special importance was given to the meeting by the fact that Sir Joseph Thomson had accepted the office of president. His address is reproduced elsewhere in this journal; we may here testify to the obvious enjoyment which its delivery gave to the audience, and ask the serious attention of headmasters to the weighty remarks concerning neglect of the German language.

The first paper was contributed by Mr. M. D. Hill (Eton), who has been led by his own experience to doubt the necessity, or even the wisdom, of previous training in chemistry and physics for young biologists. In the discussion the weight of opinion was clearly in favour of insistence on such training. Mr. E. I. Lewis (Oundle), in the next paper, argued that plant biology should be taught in every secondary school. It was a subject the interest and value of which increased throughout life. For junior pupils the subject of plant life affords a preparatory study full of suggestion for the after-study of chemistry, and it does not demand a special technical knowledge on the part of the teacher. The work can consist almost entirely of observation and experiment in the class-room and out of doors; it abounds in examples of comparative method. Another paper dealing with the sequence of subjects was read by Mr. C. E. Ashford (Royal Naval College, Dartmouth), who discussed the place of electrostatics in a school course of electricity. Mr. Ashford began by excluding from the discussion the case of those students of eighteen years and above who are studying as "science specialists" with good mathematical equipment, and invited consideration of the average boys about fifteen years old. He supported the theory which deprecates teaching subjects for their artificial "discipline," and attaches importance to the value of the "content" or subject-matter. On these grounds, and by reason of the great interest evoked in the inquiring mind of boyhood by the everyday phenomena of current electricity witnessed in modern life, it seemed good to begin with the effects of the current, and to postpone electrostatics until some idea of Ohm's law had been obtained. One unfortunate result of insistence on preliminary electrostatics had been unduly to postpone the study of electricity in those practical applications which appeal to the ordinary boy.

Mr. Ashford had been convinced by his experience at Harrow of the soundness of these propositions, and he proceeded to sketch a plan of teaching in accordance therewith. He showed by demonstrations with the current from the lighting supply, and with commercial instruments, how readily electrostatics could be made to follow the current work, and directed attention to the fact that success did not depend on the weather. Prof. Worthington criticised the details of Mr. Ashford's scheme, and advocated the older plan of taking electrostatics first. Mr. Sanderson, on the contrary, regarded the teaching of electrostatics to

young boys as part of the system of too rapid driving of immature minds. Mr. B. M. Neville had tried the plan of taking voltaic electricity early, and leading the class to the problems of electrolysis. The behaviour of electrolytes suggested the existence of discrete quantities or particles of electricity, whence the boys obtained the concept of a measurable static charge. Upon this concept the structure of electrostatics could be built. Several speakers took part in the discussion, of which the outcome appeared to us to be as follows:—Current electricity is attractive to boys, and it takes an unusually poor teacher to deprive it of its interest; electrostatics can be made very interesting by a very good teacher. As a rule, the current work is far more successful than the other. A weak spot in past teaching has been the link between current and static effects; it was felt that Mr. Ashford's demonstration would help members to strengthen that link. Supposing the first difficulty of the transition to be mastered, several of the subsequent difficulties would be in the same position whichever approach had been adopted, except for the important consideration that the boys, by previous current work, had gained some familiarity with, and confidence in discussing, the problems of potential difference, &c. If boys had to leave school before finishing the electrical course, it was more profitable to them to have had the current electricity than the electrostatics, supposing time did not allow both to be taken.

The important question of the possibility of "formal training"—in the psychological sense of the term—was introduced by Mr. A. Vassall (Harrow) in a paper of remarkable lucidity. He advised science masters to study the recent work of psychologists, and took as a particular example the problem of formal training. He was led from his own experience to doubt the "faculty psychology" by which much of our present practice is usually justified, and found that general powers of observation are not necessarily increased by special training. A boy highly trained as an observer of chemical phenomena only develops his observational powers for chemical phenomena; there is no "overflow" which will increase his general powers of observation *except where there is some identity*. We must cultivate wide knowledge and interests, and pay more attention to the subject-matter of the curriculum and less to mental gymnastics. It seemed little less than a crime to use the lower or middle-school divisions simply as a training-ground for the later study of formal science when the majority of boys in the divisions are not proceeding to such later study. There is a marked tendency so to use them at present—*e.g.* there is too much weighing and mensuration, glass-working, and other chemical manipulation. These boys should work on broad lines—in physics at such things as the electric installation of a house; in chemistry at real experiments in breathing, burning, and decay, and other topics of wide application. The ideal curriculum would give the boy (1) as much knowledge of certain subjects as is required for culture and æsthetics; (2) of other subjects only so much as will not sap his intellectual self-reliance by their being attempted beyond his capacity; (3) a special knowledge, when possible, of a subject or subjects which will be useful to him in his after-life.

Prof. Armstrong stated that he accepted neither the experiments of the psychologists nor their inferences. He was convinced that types of mind differed more than was commonly recognised. An engineering, constructive mind could only be interested, for instance, in chemistry by appealing to it through topics closely in agreement with its own bias, *e.g.* through problems concerning the corrosion of metals. We must keep in mind man's experience through the ages. Man had been accustomed only to fight, to work, and to use his commercial instinct; and almost all modern education was alien to the experience of the race. We must make our instruction practical enough and simple enough for the majority of minds, and avoid the common tendency to postpone introducing a subject to too late in age. Dr. T. P. Nunn said that psychologists were quite alive to the present imperfections of their science, and all leaders in the subject advised caution in the application of recent inferences. The idea that the mind was like a photographic plate, the sensitiveness of which to all subjects could be increased by attention to one, was quite wrong. None the less, there was a development beyond a mere record of the actual thing observed. A student by observing gained self-reliance; he learned that he was capable of drawing a rational inference without depending on external authority; he learned that he must not be in a hurry if he wished to observe aright. These acquirements *did* increase a boy's power to behave duly and perform correctly in various situations. While listening to the discussion, which was well maintained, we could not help feeling that science teachers of all grades would gain much by a study of the papers on formal training which were read by Dr. Myers, Dr. Sleight, and Mr. C. L. Burt at the London County Council Conference of Teachers during the preceding week. They would gain a clearer idea of the present position of psychology, especially of the importance of the elements common to various mental performances.

We have brought together the above four subjects somewhat out of their order in the programme of the science masters' meeting, because they appear to manifest a common tendency. They all deal with the problem of suiting the subject-matter and the order of its presentation to the growing intelligence and developing interests of the boy. A few years ago the sequence of studies in the science side of the curriculum was determined by considerations of their logical order, and no one doubted that the logical order was the right one to follow. The new movement tends to make the logical order less dominant, and to determine the sequence rather by the psychological order of the boy's mental growth. We venture to put forward our personal impression of the direction in which, judged from the general attitude of the conferences, the science curriculum is evolving. Before doing so, we note with pleasure the action of the Headmasters' Conference with regard to Greek at entrance examinations, which was taken at the December (1911) meeting.

The headmasters of the largest public schools have definitely committed themselves to action which shall relieve the preparatory schools from teaching Greek to little boys. This makes it possible for a boy during his school life to follow such a course as the following:—(1) In the preparatory school a course of practical and seasonal nature-study with gradually increasing thoroughness and method; (2) in the lower school of the public school courses of, say, astronomy and plant physiology (as suggested in the paper by E. I. Lewis); (3) in the middle school a course of physics and chemistry, in which the utilitarian interest of the boys is utilised and made more and more scientific (*cf.* C. E. Ashford and A. Vassall), the quantitative side being well-developed, but not exclusively so. It is supposed that many boys will carry school science no further than this. For those who intend to pursue scientific study after school life there will be (4) a course of systematic study in physics, chemistry, and often biology. The work in this stage may best be treated by the method of the seminar, and considerable encouragement may well be given to the historical and philosophical aspects. It may even be wise to encourage theoretical speculation in order to inculcate habits of independent, self-reliant observation and reflection. Books of reference should be used, including French and German texts, and such works as Jevons's "Principles of Science" and Pearson's "Grammar of Science" should find readers. The suggestions for this stage appear to be in harmony with Sir Joseph Thomson's address.

The annual meeting of the Mathematical Association and the remainder of the science masters' programme will receive consideration in a subsequent article; but it may be stated at once that both meetings were well attended, and showed a growth in the area of effectiveness of the societies.

G. F. DANIELL.

THE PROTECTION OF ANCIENT MONUMENTS.

THE question of the protection of ancient monuments in this country has reached a new phase by a paper recently read by Sir Schomberg McDonell, secretary to the Office of Works, before the Society of Antiquaries. He referred to numerous cases, such as those of Stonehenge, the camp at Penmaenmawr, Meavy Bridge, Chichester Cross, the wall paintings of Tewkesbury Abbey, the proposed restoration of Carnarvon Castle, as instances

in which much damage had been, or was likely to be, caused to national monuments by reckless interference. To meet this evil, he suggested the establishment of an advisory committee, composed of men eminent in archæology and public life, with representatives of the leading archæological societies, the British Museum, nominees of the Archbishops of Canterbury and York, and of the Ecclesiastical Commissioners.

It should be the duty of the committee, when satisfied that any monument of national importance was in danger, to recommend to the First Commissioner of Works that the custody of it should be assumed by the nation. On receipt of this report, the First Commissioner, if he thought fit, should move his Majesty to declare by an Order of Council that the monument was one of national importance, and was accordingly transferred to the custody of the First Commissioner. The scheme should not, he suggested, apply to dwelling houses in actual occupation, but in the case of important ecclesiastical buildings now in use he proposed that no scheme of restoration should be carried out until the plans had been passed by the advisory committee. Until the question has been more fully discussed, it would be premature to pass an opinion upon it. But, on the whole, it seems to offer a suitable remedy for a very important and growing evil.

NOTES ON MUSEUMS AND MENAGERIES.

IN *The Field* of December 9, 1911, there is an illustrated account of the new buildings recently added by the Hon. Walter Rothschild to his zoological museum at Tring, these additions considerably more than doubling the size of the original structure. As extended, the building forms three sides of a square, of which, when viewed from the front, the central transverse portion and the right wing are new. The exhibition galleries are throughout lighted by windows placed high up in the walls, so that comparatively little direct sunlight falls on the cases, this being screened, when necessary, by scarlet blinds, which are claimed by the owner to prevent all the ill-effects of actinism. The new exhibition galleries are fitted along each outer wall with a continuous series of glass and steel cases, 10 feet in height, and constructed on a modification of the principle adopted in the zoological museum at Dresden, these being stated to be absolutely dust-proof. A similar but wider series of cases, divided by a longitudinal partition of wood, occupies the middle line of each of the new galleries. The new buildings include also a library, containing 30,000 volumes, forming about 6000 separate works, workrooms, studies, &c.

With characteristic promptitude and energy, Mr. Rothschild has already arranged his specimens (which were previously crowded together) in the new cases, so that naturalists and the general public are able to appreciate the vast extent and excellent mounting of this really marvellous collection. The mounting of the larger mammals, as well as of many of the birds, has been in recent years mainly executed by Rowland Ward, Ltd. For a notice of some of the specimens in the exhibition galleries our readers may be referred to the article already cited.

The La Plata Museum forms the subject of an article by Dr. E. H. Ducloux, the vice-director, in the *Revue générale des Sciences* of November 15. That institution, which the writer considers to be the most important of its kind in South America, is the work of a single individual, Dr. H. P. Moreno; and to write the history of the former is practically the same as to write a biography of the latter, who was the first director. The museum was established by the Provincial Government in 1889 on the base of an anthropological and archæological museum founded in 1877. In its foundation Dr. Moreno had to wage an uphill fight against indifference, and sometimes hostility, in high quarters; but he eventually succeeded in getting the present palatial building erected, and brought together the wonderful collection of Argentine and Patagonian extinct vertebrates which has rendered the institution deservedly famous throughout the scientific world. It was the aim and intention of its founder that the functions of the museum should include not only science, but to a certain extent art; and, as at present constituted, its organisation embraces geography, geology, mineralogy, palæontology, botany, zoology and anatomy, anthropology (including ethnography and linguistics), and chemistry and pharmacy, while a special annexe is devoted to a school of design.

The statute of September 25, 1905, which organised the National University of La Plata—of which, according to the author, the already existing municipal scientific institutions ought to form the foundation—will, it is hoped, open to the museum a wider horizon, and remove it from the verge of penury which, under any other direction, would eventually bring about its ruin. The article contains several illustrations, one of which shows part of the wonderful series of the giant armadillos, or glyptodonts, of the Pampean epoch.

In the November number of *The Zoologist* Captain Stanley Flower concludes his notes on zoological institutions in various parts of Europe recently visited by himself. Dealing in this contribution with Stuttgart and Vienna, he remarks that, among the forty-eight institutions inspected, "the Tiergarten at Doggenburg, near Stuttgart, would be the most profitable to visit. The site is small, the collection is small, and the animals are of no great value, but the arrangement is such that everything is exhibited to its best advantage. The lover of animals who visits Doggenburg will carry away with him the impression that he has seen but few species, but these all carefully provided for and happy; the schoolchild will have seen the principal types of the vertebrate fauna of Europe, and enough exotic ones to excite his further interest; the casual visitor will not know exactly what he has or has not seen, but will feel satisfied that he has had 'his money's worth.'"

CARBOHYDRATE FORMATION IN PLANT FOLIAGE.

A VALUABLE and interesting contribution to the study of the formation of carbohydrates in the foliage leaf is contained in a paper, by Mr. John Parkin, published in *The Biochemical Journal* (vol. vi., part i.). In order to simplify the case as much as possible and to reduce the conflicting factors to a minimum, the snowdrop (*Galanthus nivalis*, L.) was chosen as the plant to be investigated, as in a previous research the author had shown that in no case is starch or inulin to be detected in the mesophyll of the leaf. It was therefore probable that maltose would be absent in the leaf also, and the research would be thus narrowed down to studying the relationship between cane sugar, dextrose, and lævulose under different conditions. The object aimed at in the beginning was to test Brown and Morris's view, enunciated in 1893, that cane sugar is the first product of carbon-assimilation in plants.

It was found, actually, that maltose is always absent from the snowdrop leaf, so that it appears probable that maltose, when present in foliage leaves, is a hydrolysis product of starch. The quantity of total sugars in the snowdrop leaf is considerable, being from 20–30 per cent. of the dry weight in leaves actively assimilating. The amount of sugar increases from above downwards in a single leaf, and, at the same time, the ratio of the cane sugar to the hexoses (dextrose and lævulose) diminishes. The *proportion* of cane sugar to the hexoses decreases as the season advances, that is to say, in the early part of the season there is more cane sugar in proportion to reducing sugar than later, the comparison being made between leaves gathered about the same period of the day. During any single day the *percentage* of hexose sugars in the leaf remains fairly constant, no matter at what hour out of the twenty-four the leaves may be examined. That of the cane sugar, however, fluctuates greatly, increasing during the day and decreasing during the night. Further, leaves detached and insolated contain decidedly more cane sugar than their controls, but the quantity of hexose sugar remains nearly the same. The lævulose, as a rule, is in excess of the dextrose, irrespective of the time of day or the period of the spring the leaves are picked for analysis.

In discussing these results, the author inclines to the view that cane sugar is, as suggested by Brown and Morris, the first sugar formed in the leaf. But they are not entirely incompatible with the idea that dextrose is the

first recognisable sugar, which recently obtained strong support from the discovery in 1907, by Strakosch, that dextrose is the only sugar present in the actual mesophyll of the leaf of the sugar beet, and that cane sugar, which is almost the only sugar in the root, first makes its appearance, together with lævulose, in the lateral veins of the lamina, and increases in amount in the midrib and petiole.

From an interesting discussion of the function of cane sugar in plants, with which the paper closes, the following may be quoted:—"Its special physical and chemical properties are of interest. It is very soluble and readily crystallises—more so than the other sugars occurring in plants. It is very easily hydrolysed by acids and by invertase. It shares with trehalose, alone among the disaccharides, in having no reducing properties. Maltose, lactose, &c., do reduce, and so may be said to have the aldehyde group in their molecule functional.

"Sucrose may thus have been selected in the higher plants as the chief circulating sugar, partly on account of its non-reducing properties and soluble (mobile) nature, and partly on account of the ease with which it can be hydrolysed into its two components, glucose (dextrose) and fructose (lævulose). These hexoses may, as a rule, play distinct parts in metabolism—the glucose more readily lending itself to the respiratory needs and the fructose to constructive work, such as the building up of the plant's framework. It is also within the bounds of probability that cane sugar itself may take a direct part in the formation of cell-walls. Just as it appears able to be condensed to starch without previous inversion, so it may be transformed directly to cellulose in the construction of cell-walls. Fenton's work is interesting in this connection. He has shown that various kinds of cellulose respond markedly to a special ketose test, and thus concludes that this substance may contain one or more groups identical with that present in fructose."

THE DEMOCRATISATION OF MATHEMATICAL EDUCATION.[1]

THE work of the Mathematical Association, in connection with its activity in promoting the reform of mathematical teaching in our schools, necessarily involves the expenditure of much time and thought upon the detailed discussion of specific schemes for the improvement of the teaching in special departments of mathematical education. It is, however, well that we should sometimes reflect upon the more general aspects of our work; and perhaps a presidential address affords the most suitable occasion for reducing some such reflections to an explicit form, even though nothing essentially new can be said upon the matter.

In making a few brief remarks upon the general character of the reform movement, I propose to emphasise one or two governing principles which I regard as of fundamental importance in relation to mathematical teaching. If I venture, in the course of my remarks, to make some suggestions on less general matters, the adoption of such suggestions as parts of the policy of the Association would only be possible after much detailed discussion of the manifold points which would have to reach some degree of settlement before the suggestions could be translated into the domain of practice.

The modern tendency which has exhibited itself in our time in greater or less degree in all countries in educational policy in general may be described as the tendency towards the democratisation of education. This term, or some synonymous one, has frequently been used to denote the extension of education to wider classes of the population; but it is not in this quite general sense that I intend here to employ the expression. I mean by it rather the progressive adaptation of educational methods to the *intellectual democracy*; the transformation of the methods of teaching and of the matter of instruction so as to meet the needs of those who are lacking in exceptional capacity, at least in relation to the particular branch of study in question; in other words, the concentration of the attention of the educator, in a much greater degree than formerly, on the work of developing the minds of the average many and not solely of those of the exceptionally gifted few. The progress of democratisation of education, in this sense, has been perhaps more marked in the case of mathematical instruction than in other departments. In our own country the Mathematical Association has been conspicuous as an agent in furthering the democratisation of mathematical education. It is very certain that no such democratisation could be effected without more or less radical changes being made both in the methods of teaching and in the selection of the matter taught. It would be of but little avail that the attention of the teacher should be concentrated in a greater degree than formerly on the average many if the methods of teaching and the material taught remained unreformed.

With a view to the formation of some estimate of the profit and loss due to the changes which have taken place of late years in the teaching of mathematics in our schools, let me briefly glance at some of the differences, both in theory and in practice, which distinguish the older and the newer methods from one another. Any exaggeration of which I may be thought guilty must find its excuse in the fact that I am attempting to indicate only the more salient features in a continuously progressive movement.

In accordance with the older and traditional treatment of mathematical instruction in our schools, geometry was treated in a purely abstract manner, the idea being that Euclid, as a supposed model of purely deductive logic, should be studied entirely with a view to the development of the logical faculty. Any knowledge of space relations which might have been imparted by this study was reduced to a minimum by the excessive insistence on all the details of the syllogistic form, the whole attention of the pupils being engrossed by the effort to commit to memory a long chain of propositions in which the actual geometrical content was exceedingly small. On the other hand, algebra, and to a great extent arithmetic, were taught without any regard to their logical aspects, but mainly as affording discipline in the purely formal manipulation of symbols in accordance with prescribed rules, little or nothing being said as to the origin of such rules. The teaching of mechanics was assimilated, so far as possible, to that of geometry, the true position of the subject as a fundamental part of physical science being almost wholly obscured. That the average boy or girl is not by nature appreciative of formal logic or of the interest and meaning of abstract symbols was thought to be a reason why the subjects so treated should be especially insisted on.

In fact, the notion of mathematical teaching was that it should be in the main medicinal and corrective. Its advantages consisted largely in calling forth the use of faculties which are the rarest in the average boy or girl, and were therefore thought to be in special need of development. It was thought to be by no means wholly a disadvantage that these subjects, so treated, were found hard and repulsive by the majority. It was thought that the hard discipline involved in the attempt to assimilate them developed a kind of mental grit, and involved a certain species of moral training, even when the intellectual results were small. A certain strengthening of faith, to be acquired in the process of hard work spent on subjects of which neither the aim nor the utility was obvious to the pupil, was thought to be highly beneficial.

It is unnecessary for me to enlarge upon the defects of this system, and on the inadequacy of the ideals underlying it. The existence of the Mathematical Association is a warrant of the widespread dissatisfaction with these methods, both in their results and their aims. The system as it existed in our schools was condemned by its failure. It failed to attain even its own narrow ideals, except in the case of a very select few among the pupils. The many rejected the material which was for them wholly indigestible mental food. The system was, in the sense in which I have used the term, undemocratic. The results obtained in the case of the vast majority were deplorable; and it needs indeed a strong faith in the anti-democratic principle to imagine that this failure was compensated by the effect of a hard and bracing training on the few who, by mental constitution, were enabled in some degree to profit by it. Even the chosen few suffered severely from the effects of the narrow conception of education which lay at the base of the methods of instruction; for the

[1] Presidential address delivered to the Mathematical Association on January 10 by Prof. E. W. Hobson, F.R.S.

purely abstract treatment failed to disclose the close relations of mathematical ideas with the physical experience in which the abstractions took their origin. That Euclid has any relation to the problems of actual space was seen by the majority of those who suffered under this system only at a later time, if at all. The relations of symbols with the concrete, and the economy of thought involved in their use, remained for the most part unappreciated; such appreciation came, if at all, as the product of later reflection on the part of a very few of those who had attained to some facility in the manipulation of the symbols.

Mais nous avons changé tout cela. The modern methods of teaching appeal in the first stages to those interests which are strongest in the majority, instead of running atilt against the most undeveloped sides of the minds of the pupils. Geometry, the science of spatial relations, is introduced by the observational and experimental study of the simplest spatial relations, verification by actual measurement playing an important part; the abstract treatment in accordance with the deductive method being relegated to a later stage. The interests of the average boy are rather practical than theoretical, therefore, it is thought, he must be interested with space relations on their practical side. He is not interested in formal logic, therefore he must not be bored with learning a chain of theorems of which the object is not apparent to him. He is not usually ingenious, therefore, it is thought, no demands must be made upon him which require ingenuity. He does not readily move in the region of abstract symbolism, therefore he must be introduced to the use of symbols only in an arithmetic manner, in which the concrete implications are prominent. Laborious exercises in algebra, in which expertness in the manipulation of symbols is the object to be attained, should, it is thought, be for the most part omitted.

Owing in large measure to the activities of the Mathematical Association, a considerable transformation in the methods and in the spirit of mathematical teaching has already taken place in many of our schools, and the changes in the direction indicated by the newer ideals are no doubt destined to have even more far-reaching effects than at present. However, the old mechanical methods of teaching still linger on in many of our schools, in which conservative traditions are notoriously difficult to eradicate. The detailed discussions, both in print and *viva voce*, which arise in connection with the work of our association may be of inestimable value in directing aright the detailed development of the reformed methods of teaching. I hope, also, they may prove useful in the direction of checking those one-sided exaggerations which are always apt to arise in connection with activities in which the objects to be attained are various, as they must be in the case of so many-sided a branch of education as the one with which we are concerned. Some degree of compromise, without undue sacrifice of principle, may often reasonably be made in adapting the teaching so as to take account of the widely diverging future careers in prospect for different classes of pupils.

It may, I think, be safely maintained that, the better the theory underlying the method of instruction may be, the more exacting will be the demands made upon the skill, the knowledge, and the energy of the teacher. My own early recollections of learning mathematics call up memories of the classical master, without any real knowledge of, or real interest in, the subjects, hearing repetition of propositions of Euclid, or setting a long row of sums in algebra, monotonous in their sameness. Somehow a few of us managed to learn something, but I tremble to think what would have been the results, had the said classical master attempted to teach in accordance with the newer methods. For the success of the teaching in accordance with the reformed methods, a high degree of efficiency on the part of the teacher is essential if the results hoped for are to be attained, and even if those results are not in some respects to fall short of what was reached under the older system. The teacher must possess a high degree of skill in presenting his material; he must have a broad knowledge of the subject, reaching much beyond the range which he has directly to teach; he must have skill and alertness in handling a class, that skill having been developed by definite training, but, of course, presupposing a natural capacity for the kind of work. Some of the failures of which one hears, of the newer methods to produce satisfactory results, may probably be traced to a falling short on the part of the teaching in one or more of the points I have indicated.

At the present time it is not possible to form any precise estimate of the actual effects of the recent reforms in mathematical teaching. It will only become possible to do so when the confusion incident to a state of transition has passed away. That in many quarters the gain has already been considerable I have no doubt. I have no doubt that the principles underlying the newer methods are sounder than those which formerly held sway. I have no doubt that it is right to proceed from the practical and concrete side of the subject, rising only gradually to the more abstract and theoretical side. But the adoption of more correct principles is only one step; their actual translation into practice gives rise to many difficulties and to many dangers, some of which have most certainly not been altogether avoided. The process of change has as yet not been one involving pure gain.

A perusal of some of the current treatises on "practical mathematics" has led me to think that in some quarters the purely practical side of mathematics is unduly emphasised. The teaching should, without doubt, commence with this side, and should never lose touch with it; but the study of mathematics must be pronounced to be a relative failure as an educational instrument if it fails to rise beyond the purely practical aspect of the subject to the domain of principle. Purely numerical work, calculation with graphs, problems in which the data are taken from practical life—all these are excellent up to a certain point, and they form the right avenue of introduction to scientific conceptions. But if this kind of work is unduly prolonged, and too exclusively practised, it tends to develop a one-sided mechanical view of the capabilities of mathematical methods, and the study ceases to be in any real sense educational. Such practical work is only educational when it precedes, and leads up to, a grasp of general principles, and when it is employed to illustrate such principles. I do not wish in the least to depreciate the importance of mathematics as providing the tools for a vast variety of applications useful in various professions. This side should never be lost sight of in school work. But the most important educational aspect of the subject is as an instrument for training boys and girls to think accurately and independently; and with this in view the more general and theoretical parts of the subject should not be entirely sacrificed either to the exigency of providing useful tools for application in after-life or to the supposed need of sustaining interest in the subject by a too anxious adherence to its concrete and practical side.

I gather that, in some of the current teaching of practical mathematics, a kind of perverse ingenuity is exhibited in evading all discussion of fundamental ideas, and in the elimination of reference to general principles. Instead of a skilful use being made of practical methods to lead up to general methods and illuminating ideas, practical rules seem sometimes to be made the end of all things. I have been told, for example, that the use of logarithms is sometimes taught to students who at no time attain to a comprehension of what a logarithm really is, or of the grounds upon which the rules for the use of logarithmic tables rest. Students who are in the habit of employing, for purposes of calculation, formulæ the origin of which they do not understand have entered upon a path which will inevitably lead to disaster, not only as regards their mental culture, but also in the practical domain. If mathematics is degraded to the level of a set of practical rules, of which the grounds are not understood, for dealing with practical problems of special types, the unscientific character of such a study will avenge itself even on the practical side of life. A student who proceeds on these lines will fail to arrive at those points of view that are not only the most stimulating mentally, but of which the attainment is really essential for success in applying mathematics to practical matters. The practical applications of mathematics are much too varied to be capable of being confined within the range of any number of prescribed rules and formulæ. Practical problems will be found constantly to arise in connection with professional work which are not quite on

the lines of the rules that have been taught, and these problems can be effectually dealt with only by persons who possess some real grasp of mathematical principles, as distinct from a mere knowledge of certain practical rules and methods. Whilst maintaining that a student should thoroughly understand the grounds upon which the formulæ and rules which he employs are based, I do not believe that he ought to be expected to commit to memory, and to be able to reproduce at any time, formal proofs of all such formulæ and rules. Much precious time and energy has been unprofitably employed in the past in attempting to satisfy the unreasonable demands made by examiners in some branches of mathematics that formal proofs should be forthcoming of everything that the candidates are supposed to have learned. The burden thus thrown on the memories of the candidates is far too heavy, and much time and energy which should have been employed in an endeavour to grasp and realise principles has thus been diverted to a far less profitable use.

It appears to me to be eminently desirable that the time saved by the diminution, in school work, of the amount of time spent on unessential details and on unnecessarily prolonged drill in the manipulation of symbols should be employed in introducing the pupils to a considerably greater range of mathematical thinking than has hitherto been usual, and in particular in endeavouring to make them acquainted with more of the fundamental and fruitful ideas which make mathematical science what it is. In the higher classes some time might profitably be spent on the principles, as distinct from the practice, of arithmetic. It would be of great educational advantage if the principles which underlie the practice with which all the pupils have become familiar were brought explicitly to their consciousness. For example, they should understand the principle of our arithmetic notation, so that they may have an adequate appreciation of its beautiful simplicity, and of the fact that it embodies a great time-saving invention. In order to attain this object it is necessary to deal with the theory of scales of notation and radix-fractions, so that the arbitrary element involved in the adoption of the scale of ten may be clearly appreciated. I do not, of course, contemplate the introduction into such a course of artificial problems on scales of notation; only the fundamental principles should be explained, with such quite simple illustrations as may be found necessary for their complete elucidation.

I do not know to what extent some rudimentary and informal treatment of the properties of simple figures in three-dimensional space has at the present time become part of the normal instruction in geometry in our schools. I am quite sure of the urgent necessity for finding time for a small modicum of study of this part of geometry. I remember, a few years ago, in a paper on mathematics for candidates for a college scholarship in physics, the candidates were asked to construct the shortest distance between two given non-intersecting straight lines. One of the candidates, who showed a considerable knowledge of plane geometry, informed me that two non-intersecting straight lines are necessarily parallels. It is unnecessary to insist upon the importance of an endeavour to uproot ignorance of this kind, due as it is to lack of stimulation of the power of observing simple spatial properties.

In considering the various directions in which mathematical teaching may be made to extend beyond the domain that consists of drill in the employment of processes which up to a certain point is undoubtedly necessary, one question of great importance arises—that is the very important question as to the possibility of making a rudimentary treatment of the ideas and processes of the calculus part of the normal course of mathematics in the higher classes of schools. In the hands of a really skilful teacher, the purely formal element in the treatment of the calculus could be reduced to very small dimensions—all the leading notions and processes could be sufficiently illustrated by means of functions of the very simplest types. I believe that some of the time saved by lightening the matter in such subjects as algebra might be more profitably employed in this manner than in any other. The calculus, as embodying and utilising the fundamental notion of a "limit," is the gate to a mathematical world of incomparably greater dimensions than the one in which the student has moved during the earlier part of his course. Any method of presentment which evades the notion of a "limit," as it appears in the differential coefficient or in kinematics as a "velocity," is much to be deprecated. The possession of this notion is the most valuable result of the study, both for educational and for practical purposes. By means of carefully chosen examples in both the arithmetic and the geometric domains, a pupil may be led up to this fundamental notion, so that it may in the end become really his own. To this end it is wholly unnecessary that any treatment of the subject should be employed which would satisfy the logician or the professional mathematician. The important point in connection with this idea, as with many others, is that the student should really have the notion as part of his permanent mental furniture, and not that he should be able to give a complete description of it, or of its philosophy, in conceptual language. I do not propose to indicate now, even in outline, a schedule of those parts of the calculus which would be suitable as part of a general education. This is a matter which might with much advantage be fully discussed by the association, when the views of practical teachers as to the possibilities in this direction would receive the fullest attention.

There is a danger which arises in connection with the democratisation of education that less than justice may be done to the minority who, by natural aptitude, are capable of making much more rapid progress than the rank and file. The danger is probably not so great in our own country as in some others; with us, the old leaven which impels teachers to make the most of their more gifted pupils still works strongly enough, and the questionable stimulus provided by scholarship examinations and other competitions exercises an influence in the same direction which is very powerful, and perhaps, indeed, too powerful. In some countries the rigid system by which every pupil in a school is taken in a general class in a certain number of years through prescribed portions of a subject acts detrimentally upon those pupils who are capable of learning much more rapidly than the average. In America I was told that it would be regarded as undemocratic to make any special provision in a school for the more rapid advance of gifted pupils. This view seems about as reasonable as it would be to prescribe, as a thoroughly democratic arrangement, that all the pupils should be supplied with boots of the same size. The general good demands that, so far as possible, equality of opportunity should be afforded to all for their mental development in accordance with their enormously varying abilities; it does not demand a mechanical equality of treatment, represented by forcing all students to move at the pace of the less gifted or of the average. Although, however, this danger may be a real one in some quarters in this country, the opposite fault, of sacrificing to some extent the needs of the average to those of the abler students, is probably still the more prevalent one.

The movement which I have spoken of as the democratisation of mathematical education is a progressive development. Something not inconsiderable has been accomplished in our time; very much more remains to be done. The difficulties which arise in this connection are largely those of finding the true coordination between the practical and the theoretical sides of the subject. An undue emphasis placed on either side is apt to have disastrous results. The perfect mean is in all such cases probably an unattainable ideal: a certain degree of compromise, depending upon a variety of circumstances, is usually the practicable course; but the most earnest endeavours should be made to prevent such compromise going too far. Whilst recognising to the full the importance of the practical side of mathematics, both as affording the right approach to the subject, in view of sound psychological principles, and also on account of its importance as an equipment for various departments of practical life, let us never lose sight of the paramount importance of mathematics as part of a real education of the intellect. Such education is incomplete unless a few, at least, of the many illuminating notions which our race has achieved in its long struggle to attain clearness in the domain of mathematical thinking are made the common property of our *intellectual democracy*.

THE FUNCTIONS OF LECTURES AND TEXT-BOOKS IN SCIENCE TEACHING.[1]

I WISH to-day to speak of a tendency in education which I think is increasing, and in my opinion is mischievous; it is one, however, which is much more rampant with us at the universities than it is at schools—I mean the practice of attempting to teach everything by lectures; of making to a continually increasing extent the lecture supply the place of the text-book; of learning everything by being told it instead of reading it for oneself.

Now I should be the last to maintain that the reading of text-books is in many branches of study sufficient by itself to give a man a real grasp of his subject. The lecture, or something equivalent to the lecture, is in many subjects, notably in science, an essential part of the educational apparatus, perhaps more essential in science than in anything else. By means of the experiments in the lectures (though these by themselves are by no means all that is required) the students see the phenomena they are studying; the experiments make them realise that they are dealing with definite phenomena, and help towards one of the most important results which the teacher has to aim at to make their acquaintance with these facts as intimate and vivid as possible.

The position I am taking this morning is not new. Let me quote here from Boswell's "Johnson":—

"People have nowadays," said he, "got a strange opinion that everything should be taught by lectures. Now I cannot see that lectures can do so much good as reading the books from which the lectures are taken. I know nothing that can best be taught by lectures, except where experiments are to be shown."

As those of you who are acquainted with that inexhaustible book are, I am sure, longing to hurl another quotation from it at me, I will disarm them by quoting it myself. It relates to an occasion when an Oxford don, Dr. Scott, was present. Johnson lectures were once useful, but now, when all can read and books are so numerous, lectures are unnecessary. If your attention fails and you miss a part of the lecture, it is lost. "You cannot go back as you do upon a book. Dr. Scott agreed with him. 'But yet,' said I, 'Dr. Scott, you yourself gave lectures at Oxford.' He smiled."

I object to the lecture usurping so largely the function of the text-book, because I think when this is done the study of a subject has not the same educational value—is not such good intellectual gymnastics, to use the cant phrase, as when a student reads it for himself. This is especially true when a student is new to the subject; with a book he can confine himself to the consideration of the new ideas, and can take his own time, while in a lecture he has to take in these ideas at the pace presented by the lecturer, and, in addition, has to put them in writing as fast as his pen can travel; as a matter of fact, in many cases he takes little trouble to understand, but confines himself to taking down as many of the words of the lecturer as is possible in the time, and trusts to finding out later on what they mean. This practically amounts to substituting a manuscript, and I think it would not be an unfair description of many such notes to say a very corrupt manuscript, for a text-book. Now it is possible that in some cases there is an advantage in doing this; the lecture may be so good that even the imperfect notes of those that heard it may be better than the best text-book available. I am assuming, of course, that there is a text-book on the subject. This, no doubt, is sometimes the case; but I think those who have read lecture notes as they are taken down will agree with me that a text-book must be quite exceptionally bad if it is not more intelligible than the majority of the notes taken even in good lectures.

Another consideration which I think is of greater weight is that if the student rewrites his rough notes, the task of reducing them to sense and logical order is an excellent mental training. I quite agree that it is, and if the student attended only one such set of lectures a term I think he might greatly benefit by doing this; but when, as he often does under present conditions, he attends three or four such courses, it is impossible for him to treat them all in this way. Consider, for example, a case that came under my observation last term. A student came to me with his time-table; he had lectures or practical work in the laboratory every morning from nine to one, and on three afternoons in the week from two to five. His object in coming to me was to find if I could not help him to find lectures to fill up the three afternoons which he had vacant.

Even though the student attends lectures, it is, I think, important that he should have training in learning for himself, and not be encouraged to think that all he need know about a subject will be told to him in lecture. In after life he will have to acquire most of his learning from books. He will not always find lectures available; it is possible, indeed, that he will have no passion for lectures, and if he has not acquired the art—for there is an art of learning from books—he will be at a serious disadvantage. Is not an excessive reliance on lectures likely to leave us open to the reproach that we teach our students everything except how to learn? I sometimes wonder when I see the extent to which some students rely on their notes, and the appallingly long list of lectures which appears at the beginning of each term, whether the importance of the invention of printing has not been overrated.

Now I must express an opinion with which I think it quite possible that many here will not agree. The view is often expressed nowadays that students should be examined by their teachers, and not by outside examiners. I cannot agree with this; so far as my experience goes, the practice leads to one of the worst kinds of cramming—the cramming of note-books—and not always the student's own note-book. I think the teacher ought to have the fullest power over the syllabus, and not to have his method of teaching hampered by external authority; but when he is given this freedom I think he may be expected to produce results which need not fear the tests imposed by any sensible examiner.

But although I am urging a freer use of text-books and more independent reading by the students, the last thing I would do would be to abolish lectures, though I should like to see them reduced in number, and in some cases their objective changed. To my mind, the proper function of a lecture is not to give the student all the information he is supposed to require on the subject of the lecture, but to arouse his enthusiasm so that he will be eager to get that information for himself. A lecture ought to be interesting and to arouse interest; dullness should be the unpardonable sin. The lecturer should avail himself of the "purple patches" of the subject to supply the momentum which will carry his students over the less exciting parts. Again, in a lecture it is possible to emphasise the fundamental parts of the subject, to discuss at length the ideas and assumptions involved, and to illustrate them by a multitude of illustrations and examples which would be impossible in a text-book of moderate size.

If lectures were limited to these objects there need not be so many of them, and there would be more time available for what I regard as the most important part of teaching—the part when the teacher comes in contact with his pupils, not as a class, but as individuals. If the teacher could talk with his pupils, even for half an hour a week, cross-examine them to see that they really understand their work, make suggestions as to what they should read, suggest points of view, sometimes even point out that things are not quite so clear as they seem to appear to the student, then I think he would have far greater influence over his pupils—would educate them better than would be done by any amount of lecturing alone. I am aware that what I am advocating is done by many teachers already, but I think there is still room for expansion of a method which the collegiate system and the large educational staff at many of our colleges make especially feasible at Oxford and Cambridge. I would like to utter a word of warning against allowing this kind of tuition to degenerate into an explanation of difficulties brought to the teacher by the student; puzzling over a difficulty is often a very good way of getting clearer ideas on a subject, and a good teacher will not solve these difficulties until he feels sure that the student will not, perhaps with

[1] Presidential address delivered to the Association of Public School Science Masters on January 11 by Sir J. J. Thomson, F.R.S.

the help of a hint or two to put him on the right track, solve them for himself.

I am told that at a school which of late years has been one of the most successful in turning out good mathematicians, the older boys are under the impression that they get very little teaching in the higher parts of mathematics; they work in a class-room together at the text-book, abuse its obscurity, argue out with each other what it really means, while the master appears to take very little part in the proceedings; as a matter of fact, if he sees that a wrong conclusion is likely to be come to by the little parliament, by an apparently casual remark he gives the argument a push in the right direction. This seems to me the very best kind of education when the boys are of fairly equal ability.

Work of this kind, when the student tries to puzzle out his own difficulties, takes time, and the student cannot cover the ground so quickly as when his difficulties are solved for him by his teacher as fast as they arise. If the examination for which he is preparing covers a wide range of subjects, he is almost compelled, or at any rate he is very strongly tempted, to adopt the quicker and easier methods. The temptation is especially strong in the case of students of science. For the Natural Sciences Tripos at Cambridge, for example, the majority of the students take four subjects in part i.; there is really no need for them to do so, and the better students are in many cases strongly advised by their tutors to take only three; if they did so I feel sure they would not prejudice their chance of getting a first class. They think, however, that it is safer to take four, and as playing for safety is a very characteristic feature of the modern undergraduate, the majority of them take this course. As they have now to do a very large amount of practical work in each subject, the study of four subjects means if they take the first part of the tripos in the second year that the whole of their mornings and many of their afternoons are spent in lecture-rooms and laboratories, and that they have very little time to spend in thinking quietly over their subject. It may be said that they have the vacations in which to do this. But, as a matter of experience, it is found, I think, that this habit is either continuous or else non-existent; it is not one that can be flung aside in term time and then resumed as soon as term is over. We cannot all emulate the heroes in the Bab Ballads:—

> These men were men who could
>   Hold liberal opinions,
> On Sundays they were good,
>   On week days they were minions.

It is, I think, most important that they should form this habit of independent thought at school, for if they have not done so the conditions are not very favourable for them to do so at the university.

The popularity of science, the great increase in the numbers attending lessons, lectures, and laboratories makes it more and more difficult to arrange that our students shall have the opportunity of thinking out their own difficulties and developing their independence and power of relying on their own resources. Let me contrast the conditions under which I began in the 'seventies the study of practical physics at the Owens College, Manchester, with those which prevail at the Cavendish Laboratory at the present time. When I was a student there were perhaps a dozen working at practical physics in the laboratory; there was no need for any elaborate organisation; we used to work at an experiment until we were satisfied we had done as much as we could, by what we thought, generally erroneously, were improvements on the methods shown to us, and acquired in this way a lively interest in our subject and some facility in devising experiments to test various points which arose in the course of our work. This, I think, is the best kind of laboratory training it is possible to have, but it is only available when the number of students is small. If we adopted it at the Cavendish Laboratory, where last term there were above three hundred students doing practical physics, the result would be chaos; while the students would not learn physics, independence, or anything except proficiency in free fighting. With such numbers elaborate organisation and preparation are unavoidable, and we have necessarily to limit ourselves to trying to make the elementary demonstrations teach the students how to make accurate measurements, to give them a knowledge of methods, and to make the experiments as illustrative as possible of the fundamental principles of physics.

I think, however, that in some of our schools the number of boys taking practical work is small enough to make the other method possible, and when this is the case I would urge as strongly as I can the danger of excessive organisation and the importance of developing as much as possible the independence and self-reliance of their pupils, and I think they might do so with safety to a small number of subjects.

I cannot refrain from alluding to the remarkable and very gratifying increase which has taken place in the last few years in mathematical knowledge possessed by the students of science sent up from the schools, and is growing rapidly from year to year. When I first went to the Cavendish Laboratory the knowledge of mathematics possessed by many of the students was so meagre that I had to start classes to teach them the elements of the differential calculus; that class has gone on until the present year; but the number who required such teaching has diminished so rapidly during the last few years that I have decided it will not be necessary to continue these classes any longer.

In conclusion, I would like to offer a suggestion, which I make with great diffidence, but it is one which, if it were possible to carry out, would increase the efficiency of the student, especially in after life, to a very considerable extent. I mean, would it be possible to teach science students enough German to enable them to translate an ordinary text-book or paper? I do not ask that they should all know German—that I realise is, at present, impracticable. I do not ask that they should be able to write German, or even pronounce it, but merely that they should be able to make sense of a straightforward sentence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is announced in *The Jewish Chronicle* that a wealthy Jew, a native of India, has bequeathed a sum of 80,000*l.* for the endowment of a Jewish college in Jerusalem. This sum is likely to form the nucleus of an endowment for a university in Palestine.

Prof. J. G. Hibben has been elected president of Princeton University in succession to Dr. Woodrow Wilson. Prof. Hibben has been professor of logic at Princeton University since 1893, and is known as the author of works on logic and philosophy.

It is announced that Sir Charles Chadwyck-Healey, K.C., who is a member of the governing body of Cranleigh School, has expressed his desire to present a laboratory to the school, and the offer has been accepted by the governors. The work has been put in hand, and it is expected that the cost will be about 4000*l.*

A Reuter telegram from Cape Town on January 13 states that, speaking at Moorresburg, Mr. F. S. Malan, Minister of Education, said he hoped to introduce and pass in the forthcoming session of Parliament a Bill dealing with higher education and the foundation of a university. Mr. Malan expects shortly to receive from Messrs. Wernher, Beit and Co., who have given half a million sterling towards the university scheme, a notification of their acceptance of the Bill, which will then be published.

At a meeting of the executive committee of the governing body of the Imperial College of Science and Technology, held on Friday last, Prof. W. A. Bone, F.R.S., professor of applied chemistry (fuel and metallurgy), University of Leeds, was appointed professor of fuel and refractory materials in a new department of chemical technology now being established in the Imperial College at South Kensington. He will take up his new duties at the Imperial College about September of this year.

In connection with the Francis Galton Laboratory for National Eugenics, a course of eight lectures will be given

at University College, London, on Tuesday evenings at 8.30 p.m., beginning on January 30. The first two lectures will be delivered by Prof. Karl Pearson, and will deal with "Sir Francis Galton: his Life and Parentage, Work and Teaching." These will be followed by two lectures on "Infantile Mortality," by Miss Ethel Elderton and Dr. M. Greenwood, jun. The fifth lecture will be on "Alcoholism," by Dr. David Heron; the sixth on "Physical Degeneracy," by Mr. Bishop Harman; and the seventh and eighth on "Heredity and Environment" and on "Social Problems," by Prof. Karl Pearson. Further particulars may be obtained on application to the secretary of the college.

AT the annual general meeting of the Royal College of Science Old Students' Association, held on January 13 at the college, Sir William Crookes, O.M., F.R.S., was elected as president of the association on the motion of Captain John Spiller, who shares with Sir William the honour of being the oldest students connected with the college. Prof. R. A. Gregory was elected as one of the vice-presidents in succession to Sir William Crookes, the remaining five vice-presidents being re-elected. Mr. T. Ll. Humberstone and Mr. A. T. Simmons were re-elected secretary and treasurer. The evidence relating to the college presented to the Royal Commission on University Education in London was to have been considered at this meeting, but owing to the lateness of the hour it was decided to adjourn the meeting, and another general meeting will be called shortly, on a date to be fixed by the committee, at which the principal business will be the discussion of this evidence. The report of the committee showed that the membership of the association had increased to 665, of whom 595 are associates of the college.

THE report of the principal of the Huddersfield Technical College, read at the prize distribution on December 21 last, has been published in pamphlet form. We find that the age of admission to evening classes was raised by one year, and the total of student hours was well maintained, in spite of the fall in the number of students which followed the raising of the age of entry. Although a number of individual students engaged in local industries attend day classes for one or more mornings or afternoons in the week, the conditions of employment seem to be unfavourable to the release of young persons during working hours for the purpose of attending classes. As yet, little success has attended efforts to make systematically organised arrangements for such students. In making recommendations with regard to the award of college diplomas, the staff has not hitherto had the advantage of any outside help or advice, such as is rendered in many university examinations by an external examiner acting conjointly with members of the university staff. To remedy this defect, the governors have sanctioned a scheme for the appointment of honorary assessors, whose cooperation and assistance will, it is expected, prove to be of value in determining these awards. There is an increasingly satisfactory relationship of the college with employers of all kinds. Cases are frequent in which students are allowed to leave work early on class nights, or are given help towards the payment of class fees or the cost of books or instruments. Much interest is displayed from time to time by employers and others in proposals for new classes, as well as in attempts to improve the existing instruction.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 11. — Sir Archibald Geikie, K.C.B., president, in the chair.—Lord **Rayleigh**: The propagation of waves through a stratified medium, with special reference to the question of reflection.—Prof. F. T. **Trouton**: The mechanism of the semi-permeable membrane and a new method of determining osmotic pressure. The amount of water taken up by a liquid, such as ether, from an aqueous solution, the solute of which is insoluble in the liquid, diminishes as the strength of the solution increases, the maximum amount taken up being from pure water. Reasons are given in the paper for expecting that the amount of water taken up from a given solution would increase under pressure, and further, that at the osmotic pressure of the solution the amount taken up would be the same as that from pure water at the atmospheric pressure. An account is also given of an experimental investigation which has verified these conclusions in the case of a 60 per cent. solution of cane sugar when osmotic pressure is about 80 atmospheres.—Dr. Alois F. **Kovarik**: Mobility of the positive and negative ions in gases at high pressures. Rutherford and Child have shown that the current i per sq. cm., between two parallel plates when an intense ionisation is confined to the surface of one plate, is given by $i=9V^2K/32\pi d^3$, where V is potential difference, d distance between plates, and K mobility of ion. When theoretical conditions are fulfilled, the current through the gas in the two directions affords a direct measure of mobility of positive and negative ions. The surface ionisation was obtained by covering one of the plates with an active preparation of *ionium*, separated by Prof. Boltwood from the uranium residues lent by the Royal Society to Prof. Rutherford. Using high pressures, ionisation is mainly confined within a very short distance of the plate. The theory was tested experimentally, and it was found that over a considerable range i varied as V^2 and inversely as d^3. The results for the mobilities of the ions in these gases are as follows:—in dry air and dry hydrogen mobility varies inversely as pressure up to 75 atmospheres, the highest used; in moist carbon dioxide the product of mobility and pressure is constant up to 40 atmospheres, but for higher pressures the product decreases as the gas approaches the liquid state. The mean values for the products of mobility and pressure in atmospheres, for the range of pressures for which the product was constant, are for negative and positive ions, respectively, in dry air 1·89 and 1·346, in dry hydrogen 8·19 and 6·20, and in moist carbon dioxide 0·67 and 0·705 cm. per sec., for a potential gradient of one volt per cm.—G. A. **Shakespear**: A new method of determining the radiation constant. The rate of loss of heat of a silvered surface at a temperature of 100° C. in surroundings at 15° C. is observed (*a*) when the surface is polished, (*b*) when it is lamp-blacked. The difference is due to difference in radiation losses. The ratio of the rates of radiation is obtained by exposing the two hot surfaces in turn to a radiomicrometer. The rate of radiation from the lamp-black is assumed to be proportional to the difference between the fourth powers of the absolute temperatures 373 and 288. The lamp-black at 100° C. is compared with a full radiator at the same temperature by means of the radiomicrometer. Certain corrections are necessary, and these are dealt with in the paper. As a check on the comparison given by the radiomicrometer, an instrument which constitutes a closer approximation to a full receiver was devised and used. It was found, incidentally, that the apparent radiation from lamp-black depends upon the surface upon which the lamp-black is deposited. The value obtained for σ is $5{\cdot}67\times10^{-5}$ ergs per sq. cm. per sec. per deg^4.—Dr. R. A. **Houston**: The mechanics of the water molecule. Suppose that a hydrogen atom loses one electron to a second hydrogen atom, and that the second hydrogen atom loses two electrons to an oxygen atom. Then the oxygen atom has two negative charges, each hydrogen atom one positive charge, there will be one line of force between the first and second hydrogen atoms and two lines of force between the second hydrogen atom and oxygen atom. Let the three lines of force act as equally strong spiral springs, and let a wave of light pass through a medium composed of such molecules. It is shown in the paper, by means of the ordinary theory of dispersion, that the absorption spectrum of such a medium consists of two bands, the ratio of the wave-lengths of which is 2·32. Also from the intensity and width of each band it is possible to calculate e/m, the ratio of unit charge to the mass of the hydrogen atom. Water is transparent in the ultra-violet and visible spectrum, and has two great bands in the infra-red at 3·07 μ and 6·15 μ, which are not present in oxygen or hydrogen. It is shown in the paper that the values of e/m calculated from these bands are respectively 7110 and 1550 electromagnetic units. Hence the structure assumed for the molecule cannot be far off the truth.

Geological Society, December 20, 1911.—Prof. W. W. Watts, F.R.S., president, in the chair.—Rev. E. **Hill**: The glacial sections at Sudbury (Suffolk). The sections round Sudbury were described in two Geological Survey Memoirs: since the date of publication of these much more has been disclosed. A list is given of the principal sections now existing, with references to the descriptions in the Survey Memoirs and notes of those that are there undescribed. The paper gives an account of a series of sands and silts which lie at about 200 O.D. on each side of the present Stour Valley. They seem to indicate shallow-water conditions at a level more than 100 feet above the present valley-floor. On the silts lies Chalky Boulder Clay. The transition from silt to clay is continuous, and seems to show that here the transition from formation of silt to formation of Boulder Clay was a continuous transition. The undisturbed condition of the beds indicates that during this transition there was no action of thrust or drag. At lower levels, from 180 O.D. down to 100 O.D., on the flanks of the valley lie coarse gravels and sands, with current-bedding, which point to torrential water-action. Among these occur displaced masses of previously formed Boulder Clay, some contorted—as if by slip down slopes. At Little Cornard brickworks there is associated with current-bedded gravels a clay in which are embedded very large masses of remade Chalk. The deduction from these facts is that at Sudbury Boulder Clay began to be formed where there was quiet water, which stood on both sides of the valley at a level of more than 120 feet above the present floor, and that, after such clay had been formed, there came to be strong currents into or along the valley at various lower levels. These deductions agree with the probable course of events if a submergence preceded the Chalky Boulder Clay and an emergence followed it.—C. I. **Gardiner** and Prof. S. H. **Reynolds**: The Ordovician and Silurian rocks of the Kilbride peninsula (County Mayo). The Kilbride peninsula includes three principal groups of rocks. The northern and western part is, in the main, composed of igneous rocks, contemporaneous and intrusive, of Arenig age; the southern and eastern part principally consists of Silurian rocks, but these are in the south-eastern corner of the peninsula faulted against an area of gneiss. The Arenig rocks resemble the Mount Partry beds of the Tourmakeady and Glensaul districts in the fact that they include cherts and shaly beds with *Didymograptus extensus*, and in the presence of gritty tuffs and coarse breccias, the latter rocks showing a magnificent development. No coarse conglomerates, however, occur, and no limestone-breccias or other representatives of the Shangort beds of Tourmakeady and Glensaul, while Arenig sediments of all kinds are very scarce. The most interesting feature of the Arenig rocks is the great development of spilitic lavas, which are commonly associated with cherts and often show good pillow-structure. Their resemblance to the similar rock of the Girvan district is very close. An enormous mass of felsite with large quartz-phenocrysts, and often albite, as also pseudomorphs after rhombic pyroxene, occupies much of the northern part of the peninsula. There is no doubt that it, like the similar masses of Tourmakeady and Glensaul, is of Arenig date. The Silurian rocks consist principally of grits, sandstones, and calcareous flags, and dip with great regularity in directions varying from south to east. The calcareous flags (Finny School beds) are highly fossiliferous, and have yielded more than fifty species, principally of corals and brachiopods, which prove the beds to be of Llandovery age. Ill-preserved specimens of *Monograptus vomerinus*, found in the highest Silurian strata exposed, show that these are of Wenlock age. Dr. Henry Woodward, F.R.S., supplies an appendix giving a description of a new species of Caryocaris.

Mathematical Society, January 11.—Dr. H. F. Baker, president, in the chair.—G. H. **Hardy** and J. E. **Littlewood**: A new condition for the truth of the converse of Abel's theorem.—A. **Cunningham**: Mersenne's numbers.—W. H. **Young**: Successions of integrals and Fourier series.—W. H. **Young**: Multiple Fourier series.

Royal Astronomical Society, January 12.—Dr. Dyson, president, in the chair.—H. C. **Plummer**: Hypothetical parallaxes of the brighter stars of type A. The paper was an investigation of the radial velocities of brighter stars in a list furnished by Dr. Campbell. The velocities of class A stars near the Milky Way are greater than those of stars in high latitudes. This fact suggests that stars of type A have a tendency to move parallel to the plane of the Milky Way.—F. G. **Brown**: The absorption of light in space. For a determination of this absorption the author made use of nebulæ, for, since these possess a measurable diameter, their distances can be approximately determined. Nebulæ having a small apparent diameter must be, on an average, more distant than the larger objects, however their real diameters may differ.—H. H. **Turner** and F. G. **Brown**: An example of the use of spherical harmonic analysis. The authors showed the advantages of this analysis in various astronomical investigations, and gave an example, which also brought out the main features of the distribution of brightness of nebulæ in different parts of the sphere.—W. G. **Thackeray**: Personality and bisection error of some Greenwich transit-circle observers. The author's object was to obtain a determination of the magnitude equation in R.A. of the present regular observers with the transit circle. It seems clear that the bisection errors vary with the zenith distance, and these personalities may be due partly to the eye and partly to the different positions taken up by the observer, according to the zenith distance of the star observed.—C. P. **Butler**: An account of a new form of telescope recently constructed in America. The instrument was a modification of the principle of the equatorial *coudé*, the polar axis being also hollow, but so large that the observer was actually within it.

PARIS.

Academy of Sciences, December 26, 1911.—M. Armand Gautier in the chair.—M. **Gouy**: A particular case of interkathodic action.—M. **de Forcrand**: The ethylates of calcium. The product of the action of ethyl alcohol on metallic calcium, its hydride, carbide, or nitride, is an alcoholate of calcium ethylate having the formula

$$(C_2H_5O)_2Ca + 2C_2H_5OH.$$

When this substance is kept over sulphuric acid it loses ethyl ether and ethylene, until after several years its composition approximates to $(C_2H_5O)_2Ca + 5Ca(OH)_2$. This is due to a catalytic action of lime, invariably present in the original compound, on the ethyl alcohol and calcium ethylate.—D. **Eginitis**: Observations on Brooks's comet (1911*c*) made at the Observatory of Athens. Observations on the position, magnitude, and appearance of the comet on various dates between August 23 and September 22.—G. **Pick**: Parallels, and differential geometry in non-Euclidean space.—René **Garnier**: The simplifications of a class of differential systems of which the general integral has fixed critical points.—G. **Kowalewski**: A class of infinitesimal transformations of functional space.—P. **Montel**: The indeterminate character of a uniform function in the neighbourhood of its essential points.—A. **Blondel**: Singular values of unsymmetrical nuclei.—Maurice **Potron**: Some properties of linear substitutions with coefficients ≥ 0 and their application to the problems of production and wages.—M. **Rosenblatt**: Algebraic surfaces admitting a discontinuous series of birational transformations.—E. **Barré**: Minimum surfaces generated by circular helices.—Émile **Giurgea**: Researches on the "Kerr effect" in gases and vapours. According to Lippmann, gases and vapours should, in an electric field, show an effect similar to the "Kerr effect" in solid and liquid dielectrics, resulting in a contraction given by the formula $\frac{\Delta v}{v} = \frac{K-1}{8\pi p}\frac{E^2}{\epsilon^2}$, the effect being proportional to the square of the field, and becoming greater as the dielectric constant K of the gas is greater. An interferential method was used, and the effect expected was produced to a very small extent by vapours having large values of K, for example, C_2H_5Br, CS_2, CCl_4, but it could not be elicited in air and CO_2, even under 25 atmospheres pressure.—E. **Estenave**: Synthesis of complementary colours by means of gratings. One side of a glass plate is ruled with parallel lines alternately green and red, and the other with black lines parallel to the coloured ones. When this plate is viewed

at a distance of about 30 cm. it appears red to one eye and green to the other, but when both eyes are used it appears greyish-white. The synthesis of red and green to form white is thus performed by the observer.—Edmond **Bauer**: The theory of radiation.—L. **Décombe**: The heat of Siemens, and the conception of capacity.—A. **Lafay**: The phenomenon of Magnus.—J. **Delvalez**: Representation of equipotential lines in electrolysis. Claim to priority against A. Brochet.—O. **Boudouard**: Electrical resistance of special steels. Measurements were made of the resistances of nickel, manganese, chromium, and tungsten steels, containing the metals mentioned and carbon, in very varying proportions.—P. **Mélikoff**: Method for separating phospho-molybdates from silico-molybdates. The molybdate test for phosphoric acid possesses the defect that silicic acid is also precipitated, and it is often desirable to have a means of distinguishing between the compounds. This is found in ammonium permolybdate solution (equal volumes of 30 per cent. H_2O_2 and of an 8 per cent. solution of ammonium molybdate in nitric acid), which will dissolve the phospho-molybdate, but not the silico-molybdate.—Oechsner **de Coninck**: Molecular weight of lime; atomic weight of calcium. Determinations of these constants by the ignition of calcium formate to the oxide, and by precipitation of the oxalate and its subsequent ignition also to the oxide. The mean value found was Ca=40·02.—A. **Raynaud**: Solubility of the oxide UO_2 in various acids. The anhydrous oxide dissolves very sparingly in hydrochloric, hydrobromic, sulphuric, and acetic acids, but is easily soluble in nitric acid and in nitro-hydrochloric acids, with production of uranyl salt.—E. **Boismenu**: Hypochlorous amides. An attempt was made to combine hypochlorous acid with amides to form hypochlorites of the amides, but instead of these mono- and di-chloro-derivatives were formed. Of these, mono- and di-chloroacetamide, dichloropropionamide, and dichloroformamide are described.—A. **Gascard**: Three normal saturated hydrocarbons: triacontane, tetratriacontane, and hexatriacontane. Triacontane, $C_{30}H_{62}$, was obtained as follows:—the palmitate of pentadecyl alcohol was obtained by the action of iodine on silver palmitate; this was then hydrolysed, and the alcohol converted into pentadecyl iodide, and this by the action of sodium into triacontane. The other hydrocarbons were made similarly.—Marcel **Guerbet**: Action of caustic potash on primary alcohols; preparation of the corresponding acids. The oxidation of primary alcohols by caustic potash always yields the corresponding acid, even in the case of complex alcohols, and the yield is generally good.—Henri **Coupin**: Localisation of the pigments in the integument of haricot beans.—M. **Guilliermond**: The origin of the leucoplasts, and on the cytological processes in the elaboration of starch in the potato.—M. **Delassus**: Influence of the partial suppression of the reserves of the seed on the development of the plant.—G. **André**: Removal by water of the soluble substances contained in the potato.—Em. **Bourquelot** and A. **Fichtenholz**: Application of the biochemical method to *Kalmia latifolia*, and isolation of a glucoside.—L. **Ravaz** and G. **Verge**: Mode of infection of the leaves of the vine by *Plasmopara viticola*.—Maurice **Arthus**: The specific nature of antitoxic sera. Sera for use against various snake-poisons. Poisons of *Lachesis lanceolatus*, *Crotalus terrificus*, and *C. adamanteus*. The action of these antitoxic sera is, with rare exceptions, quite specific.—Raphaël **Dubois**: The vacuolides of the colour-producing organ (of Murex).—H. **Dominici**, G. **Petit**, and A. **Jaboin**: Persistent radio-activity of the organism under the influence of radium in an insoluble form. In the case of a horse injected with 1 milligram of radium sulphate, the blood was still radio-active a year later.—M. **Cluzet**: Instantaneous radiography of the diaphragm in tabetics.—H. **Claude** and A. **Baudouin**: The effects of certain extracts of hypophysis.—Gabriel **Bertrand** and M. and Mme. **Rosenblatt**: Activation of sucrase by various acids.—Jacques **Parisot**: Transformation of blood pigment into bile pigment under the influence of adrenaline.—L. **Launoy** and C. **Levaditi**: Researches on the therapeutic action of mercury in experimental syphilis of the rabbit. Some of the complex thio-derivatives of mercury are very active against the spirochæte pallida, but not against the spirillum of relapsing fever.—Ch. **Nicolle** and E. **Conseil**: Experimental production of measles in monkeys.—Henri **Violle**: The gall bladder as a point of inoculation.—MM. **Radais** and **Sartory**: The toxicity of *Amanita phalloides*. The toxicity of this fungus does not disappear after exposure to a temperature above 100°, and the dried fungus is still active after several years' keeping.—A. **Rochaix** and G. **Colin**: Staining of the tubercle bacillus. Non-specific nature of the granulations of Much.—J. **Repelin**: Observations on the geology of the Sainte-Baume.—V. **Commont**: Geological age of Quaternary remains.—Julien **Loisel**: Distribution of solar heat over France.—Henri **Fournier** presented a memoir on flight, which was referred to the Committee on Aëronautics.

January 2.—M. Armand Gautier, the retiring president, made his report to the academy, and was succeeded in the chair by M. G. Lippmann.—A. **Laveran** and Nattan **Larrier**: *Trypanosoma rhodesiense* (Stephens and Fantham). Human sera, which are inactive against *T. gambiense*, are active towards *T. rhodesiense*; this latter trypanosome is distinct from *T. gambiense* and from *T. brucei*.—MM. **Lambert, Ancel,** and **Bouin**: A novel means of defence of the organism. Skeptophylaxis. Extracts of certain organs, for instance, of corpus luteum, thyroid, or brain, ground up with sand, mixed with ten times their weights of normal saline, and centrifugalised, are highly toxic when injected without filtration. If, however, a toxic dose is divided unequally, and the smaller part injected first, followed by the larger within a few minutes, these toxic effects are not produced. To this very rapid protective action the name skeptophylaxis is given.—Émile **Borel**: The shuffling of cards. Calculus of probabilities; an extension to the case in which the probabilities of operations vary with the time.—H. **Parenty**: A form of meter. Description, with diagram, of the author's piezometric meter.—André **Léauté**: The development of a function in exponential series; application to the 100,000-volt installation at the Turin Exhibition.—R. **Fric**: The action of heat on nitrocellulose and nitrocellulose powders. The alteration by heat of these substances is indicated by the relative times of flow, through a narrow tube, of equal quantities of their solutions in acetone. The time of flow is decreased by subjecting the materials to heat.—Louis **Marmier**: Action of ultra-violet rays on sodium hyposulphite. A solution of sodium hyposulphite containing 6 grams per litre, after five minutes' exposure, produces sodium hydrosulphite with deposition of sulphur. Longer exposure destroys the hydrosulphite, with formation of sulphite. With higher concentrations the hydrosulphite is not formed.—Z. **Tchougaeff** and Mlle. D. **Fraenkel**: Some complex compounds of platinous bromide with organic sulphides. Bromo-platinous acid, H_2PtBr_4, like chloroplatinous acid, unites with organic sulphides to form crystalline derivatives, generally insoluble. These are bromoplatinites of complex bases, and are easily transformed by heat into isomers.—C. L. **Gatin**: The structure of the germ in Zingiberaceæ and Marantaceæ.—Lucien **Daniel**: Some abnormal methods of separation of grafts.—F. **Houssay** and A. **Magnan**: The wing-surface and tail in birds.—A. **Conte**: A hymenopterous parasite of the hive moth.—Henri **des Gayets** and Clément **Vaney**: Some observations on cattle-fly from the point of view of stock-raising.—G. **Raymond**: Results of photoelectric measurements made at Antibes during 1911.

BOOKS RECEIVED.

Illustriertes Handbuch der Laubholzkunde. By C. K. Schneider. Elfte Lieferung. Pp. 657–816. (Jena: G. Fischer.) 5 marks.

Die heteroplastische und homöoplastische Transplantation. By Dr. G. Schöne. Pp. v+161. (Berlin: J. Springer.) 8 marks.

Annuaire pour l'an 1912. Publié par le Bureau des Longitudes. Pp. vi+692+A.47+B.34+C.43. (Paris: Gauthier-Villars.) 1.50 francs net.

Elements of Agriculture. By the late Dr. W. Fream. Eighth edition. Edited by Prof. J. R. Ainsworth-Davis. Pp. xiv+692. (London: J. Murray.) 5s. net.

Soap-bubbles: their Colours and the Forces which

Mould them. By C. V. Boys, F.R.S. New and enlarged edition. Pp. 190. (London. S.P.C.K.) 3s.

Die Partiellen Differential-Gleichungen der Mathematischen Physik. Nach Riemann's Vorlesungen. By Prof. H. Weber. In fünfter Auflage. Zweiter Band. Pp. xiv+575. (Braunschweig: F. Vieweg & Sohn.) 15 marks.

Nietzsche als Bildner der Persönlichkeit. By Dr. R. Oehler. Pp. 31. (Leipzig: F. Meiner.) 60 pfg.

Untersuchungen über Pfropfbastarde. By Prof. H. Winkler. Erster Teil. Pp. viii+186. (Jena: G. Fischer.) 6 marks.

The Alphabet of the National Insurance Act, 1911. By C. G. Morgan. Pp. vi+164. (London: Methuen and Co., Ltd.) 1s. net.

Laboratory Exercises in Physical Chemistry. By Dr. J. N. Pring. Pp. xii+162. (Manchester and London: Sherratt and Hughes.) 4s. net.

Stars and Constellations: a Little Guide to the Sky. By A. Fry. Pp. 39. (Clifton: J. Baker and Son.) 6d. net.

An Introduction to Eugenics. By W. C. D. Whetham, F.R.S., and C. D. Whetham. Pp. viii+66. (Cambridge: Bowes and Bowes.) 1s. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—The Physiological Effects of Low Atmospheric Pressures, as observed on Pike's Peak, Colorado (Preliminary Communication): Dr. J. S. Haldane, F.R.S., C. G. Douglas, Prof. Y. Henderson, and Prof. E. C. Schneider.—On the effect of altitude on the dissociation curve of the blood: J. Barcroft, F.R.S.—Note on *Astrosclera willeyana* Lister: R. Kirkpatrick.—*Herpetomonas pediculi*, nov. spec., parasitic in the Alimentary Tract of *Pediculus vestimenti*, the Human Body Louse: Dr. H. B. Fantham.—Antelope Infected with *Trypanosoma gambiense*: Capt. A. D. Fraser, R.A.M.C., and Dr. H. L. Duke.

ROYAL INSTITUTION, at 3.—The New Astronomy: Prof. A. W. Bickerton.

LINNEAN SOCIETY, at 8.—Some Features of the Marine Flora of St. Andrews: Dr. A. Anstruther Lawson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Old District Records of Bengal: Rev. W. K. Firminger.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: Residence Tariffs: A. H. Seabrook.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Submerged Flexible-joint Main: F. Reed.—Unwatering Tresavean Mine: C. Brackenbury.—Notes on the Operation of Two Winding Engines: H. M. Morgans.—Stoping at the Calamon Mine: C. P. Corbett Sullivan.

FRIDAY, JANUARY 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Evolution and Present Development of the Turbine Pump: Dr. Edward Hopkinson and Alan E. L. Chorlton.

ROYAL INSTITUTION, at 9.—Heat Problems: Sir J. Dewar, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Turbo-blower and Turbo-compressor: G. Ingram.

SATURDAY, JANUARY 20.

ROYAL INSTITUTION, at 3.—The Banyoro—A Pastoral People of Uganda; (1) The Milk Customs: Rev. J. Roscoe.

MONDAY, JANUARY 22.

ROYAL SOCIETY OF ARTS, at 8.—Ocean Waves, Sea-beaches, and Sandbanks: Dr. Vaughan Cornish.

ARISTOTELIAN SOCIETY, at 8.—The Relation of Willing to Cognition: Prof. G. Dawes Hicks.

AËRONAUTICAL SOCIETY, at 8.30.—The Development of Animal Flight: Dr. E. H. Hankin.

VICTORIA INSTITUTE, at 4.30.—The Conditions of Habitability of a Planet, with special reference to the Planet Mars: E. W. Maunder.

TUESDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Anniversary Meeting.—8.30.—Some American Problems: A. P. Maudslay.

MINERALOGICAL SOCIETY, at 5.30.—The Relationship between Crystalline Form and Chemical Constitution; the Double Chromates of the Alkalies and Magnesium: Miss M. W. Porter and Dr. A. E. H. Tutton.—On Liveingite: Prof. W. J. Lewis.—A New Anorthic Mineral from the Binnenthal: R. H. Solly and Dr. G. F. H. Smith.—On Colemanite and Neocolemanite: Dr. A. Hutchinson.—Further Observations on the Optical Characters of Gypsum: Dr. A. Hutchinson and Dr. A. E. H. Tutton.—Note on a Large Crystal of Anatase from the Binnenthal: Dr. G. F. H. Smith.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Reinforced Concrete Wharves and Warehouses at Lower Pootung, Shanghai: S. H. Ellis.—The Direct Experimental Determination of the Stresses in the Steel and in the Concrete of Reinforced-Concrete Columns: W. C. Popplewell.—Composite Columns of Concrete and Steel: W. H. Burr.—*Probable Paper*: The Central Heating and Power-plant of McGill University, Montreal: R. J. Durley.

WEDNESDAY, JANUARY 24.

ROYAL SOCIETY OF ARTS, at 8.—A New Process of Hydraulic Separating and Grading: W. J. Gee.

GEOLOGICAL SOCIETY, at 8.—The Upper Keuper (or Arden) Sandstone and Associated Rocks of Warwickshire: Dr. C. A. Matley.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Determination of the Co-efficient of Interdiffusion of Gases and the Velocity of Ions under an Electric Force, in terms of Mean Free Paths: Prof. J. S. Townsend, F.R.S.—Note on the Scattering of α Particles: Dr. H. Geiger.—The Effect of Temperature upon Radioactive Disintegration: A. S. Russell.—On the Relation between Current, Voltage, Pressure, and the Length of the Dark Space in Different Gases: F. W. Aston and H. E. Watson.—On the Viscosities of Gaseous Chlorine and Bromine: Dr. A. O. Rankine.—The Testing of Plane Surfaces: Dr. P. E. Shaw.

ROYAL INSTITUTION, at 3.—The New Astronomy: Prof. A. W. Bickerton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Heat Paths in Electrical Machinery: Miles Walker and H. D. Symons.

FRIDAY, JANUARY 26.

ROYAL INSTITUTION, at 9.—The Pressure of a Blow: Prof. B. Hopkinson, F.R.S.

PHYSICAL SOCIETY, at 5.—Exhibition of a Direct-reading Instrument for Submarine Cable and other Calculations: R. Appleyard.—On the Vibration Galvanometer and its Application to Inductance Bridges: S. Butterworth.—Note on a Negative result connected with Radio-activity: J. H. Vincent and A. Bursill.—On Sealing-metals: Dr. P. E. Shaw.—Krypton and the Auroral Spectrum: T. W. Page.

SATURDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—The Banyoro: A Pastoral People of Uganda: (2) Birth and Death Customs; Rev. J. Roscoe.

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THURSDAY, JANUARY 25, 1912.

ANCIENT HUNTERS.

Ancient Hunters and their Modern Representatives. By Prof. W. J. Sollas, F.R.S. Pp. xvi+416. (London: Macmillan and Co., Ltd., 1911.) Price 12*s.* net.

TO write a history of the early races of mankind is, at the present time, a most bold undertaking. A writer needs to bring to the task not only an expert knowledge of geology, an intimate acquaintance with the structure of man and beast, but also the long experience of those who have studied the culture—above all, the implements of primitive races. The difficulties of the task are increased by the extensive and technical literature which grows in volume year by year. Prof. Sollas has faced these difficulties with success, and under the rather inadequate title of "Ancient Hunters" produced a book which in reality aims at giving the early history of mankind.

"I believe," he says in the preface, "this is the first time that a general survey has been attempted—at least in the English tongue—of the vast store of facts which have rewarded the labours of investigators into the early history of man during the past half-century."

Those who are making a special study of ancient man are indebted to Prof. Sollas for the survey; it will prove no less acceptable to those who wish to make an acquaintance with this subject, for it is written in a simple and interesting style. The text is furnished with a plentiful supply of good and accurate illustrations.

We naturally turn first to see what Prof. Sollas has to say concerning the Pleistocene epoch, when his "ancient hunters" were living in Europe. The length of that period does not exceed, he believes, 300,000 to 400,000 years, and accepts Prof. Penck's four terraces on the valleys of alpine rivers as evidence that the Pleistocene epoch was divided by four periods of glaciation, each followed by a temperate interval, the fourth giving us our present moderate climate. Indeed, according to Prof. Sollas, we do not seem to have left the last glacial period far behind us. He takes the reader back 7000 years, and writes:—

"From this point—the beginning of the seventh millennium—we look backwards over the last glacial episode. The curve of temperature descends in a valley-like depression, the bottom of which corresponds with the period of intense glaciation."

The period which has elapsed since the last glacial period is estimated from the unsatisfactory data of Heim and of Baron de Geer to have been about 17,000 years.

The writer gives one the feeling of living on an earth with a very unstable climate, and yet in the last 7000 years there seems to have been no change. Prof. Sollas does not think that there is any satisfactory evidence of the existence of man before the beginning of the Pleistocene period. The eoliths attributed to man—Harrison's flints of the Kent Plateau, the sub-crag flints—are rejected as convincing evidence of man's existence. The earliest stone implements which carry a conviction to him of human workmanship are those found by M. Rutot in the Misvinian gravels of the valley of the Lys. The earliest remains of man himself—the Heidelberg jaw and the fossil remains from Java—he attributes to the first interglacial period, with the proviso that further evidence may place them at a later date. The Neanderthal race appeared before the last glacial episode, while the Cro-magnon race succeeded it. In these matters Prof. Sollas is in agreement with most of his Continental colleagues.

The civilisation of ancient and extinct races of mankind must be interpreted from our knowledge of the culture of surviving primitive races. Prof. Sollas has laid hold of that fact, and in many cases used it to excellent purpose. Yet in some cases his inferences are not well founded. He sees many points in common between the art of the modern Bushman of South Africa and the race who decorated the caves of Spain and France towards the close of the Pleistocene period. He also regards the Grimaldi human bones found in a cave near Mentone to be remains of that ancient artist race, and holds that the evidence "that Mentone was inhabited in Aurignacian times by a race allied to the Bushman amounts almost to positive proof." It is true that these Grimaldi people show negroid traits, and so do the Bushmen, but it would be difficult to find two negroid types which are more sharply differentiated in the characters of their skull and face than these ancient and modern negroid races. It is strange that Prof. Sollas does not allude to the best known of the Aurignacian men, the one discovered by Herr Hauser at Combe-Capelle in 1909, nor do the remains found at Furfooz, at Grenelle, and at Engis, come up for consideration; yet we may suppose them to belong to ancient hunters, and to be of importance because of the types which they represent. On the other hand, we find he accepts the peculiar and isolated skeleton discovered at Chancelade, in the south-west of France, as evidence that a race, very similar to modern Eskimos, lived in Europe about the same time as the Aurignacian and Cro-magnon men. Those who have studied the Chancelade skeleton in the Museum at Perigueux will hesitate to accept its identification by Prof. Sollas as Eskimo in character, and will find it difficult to follow him when he traces the dispersion of European Eskimo and other races in the continent of America.

This book has great merits; it will succeed, and it deserves success. Yet we do wish England had received some attention, were it only a fraction of what has been bestowed on France and neighbouring countries. Cresswell Crags, Kent's Hole, the Oban caves receive a passing notice, but the Thames Valley and its terraces—the very subjects on which Prof. Sollas can give an expert opinion—receive very scanty treatment. The human remains from the 100-foot terrace at Galley Hill and from the submerged strata at Tilbury are passed over in silence. Perhaps in another edition Prof. Sollas will make these omissions good.

STABILITY IN AVIATION.

Stability in Aviation: an Introduction to Dynamical Stability as Applied to the Motions of Aeroplanes. By Prof. G. H. Bryan, F.R.S. Pp. xi+192. (London: Macmillan and Co., Ltd., 1911.) Price 5s. net.

THIS book, in common with other published mathematical papers of Prof. Bryan, contains much original work. It is well worth study, not merely by mathematicians, but also by all interested in the practice of aviation and in the design of flying machines. In the preface and introduction the author indicates his reasons for undertaking this investigation, and his desire to make the book practically useful. It will be universally agreed, and the conclusion is confirmed by experience, that the greatest difficulties which must be surmounted in connection with aërial navigation arise from lack of exact knowledge of the principles of dynamical stability as applied to the motions of aëroplanes. Up to date it is probably correct to say that individual skill—often apparently almost instinctive—on the part of airmen, and their immediate readiness to act when sudden emergencies arise, play the greatest part in the safe conduct of aërial machines. In fact, having regard to endless possible variations in the conditions which are, and will be, encountered in aërial navigation, these personal qualities will always remain essential to success. On the other hand, there can be no dispute but that substantial advantages may be gained from the results of work done by mathematicians like Lord Rayleigh, Sir George Greenhill, and Prof. Bryan.

It is true that all mathematical investigations must be based on certain assumptions; and, because of our imperfect knowledge of atmospheric phenomena, errors have been, and will be, made in these assumptions, and important considerations may be omitted in framing equations. In consequence of these limitations mathematicians run a risk of claiming more for their conclusions than they are really worth. Prof. Bryan himself has not escaped entirely free from this danger in previous utterances on the subject of aviation; but in the book under review he puts the case for mathematical inquiry in a form to which no one will take exception. The passage is of sufficient interest to justify quotation, and the more so because it strikes the keynote of the book itself:—

"In this book attention is concentrated on the mathematical aspect of the problem for several reasons. In the first place, there is no obvious alternative between developing the mathematical theory fairly thoroughly and leaving it altogether alone; any attempt at a *via media* would probably lead to erroneous conclusions. In the second place, the formulæ arrived at, even in the simplest cases, are such that it is difficult to see how they could be established without a mathematical theory. In the third place, there is probably no lack of competent workers interested in the practical and experimental side of aviation, and, under these conditions, it is evident that the balance between theory and practice can be improved by throwing as much weight as possible on the mathematical side of the scale. Lastly, it is hoped to advocate the claims of aëroplane equilibrium and stability as an educational subject suitable for study in our universities alongside with such branches of applied mathematics and mathematical physics as hydrodynamics, and particle and rigid dynamics."

If it were necessary to choose between purely mathematical investigation and experimental research in connection with the development of aviation, the latter method would necessarily be preferred. No such choice has to be made, however, since progress can only be achieved if there is a close association of mathematical analysis with experimental methods.

Readers of Prof. Bryan's book will be impressed with the suggestiveness of many passages in which results of mathematical solutions of difficult problems are discussed. Even if all the mathematical processes in the book cannot be followed by practical men, their attention may well be turned to its pages, and they cannot fail to derive instruction and obtain guidance therefrom in determining directions in which further experimental research may most advantageously be undertaken.

Prof. Bryan anticipates "that the successful aëroplane of the future will possess inherent, not automatic, stability, movable parts being used only for the purposes of steering." He considers the use of gyrostats, pendulums, or other movable parts which are intended to provide automatic stability to be undesirable, because such parts are liable to get out of order, while "they increase the degree of freedom of the machines and add to the number of conditions which have to be satisfied for stability." There is sound common sense in this observation, and its force has been emphasised by experience in submarines. After many attempts to devise and apply means for automatic control of longitudinal stability, it has been universally agreed that manual control by competent steersmen is on the whole to be preferred. The case of the submarine is, of course, vastly simpler, and the conditions of service less complex and variable than are those to which aërial machines are exposed; but the principle holds good in both instances. The "human element" is all-important.

It is both unnecessary and undesirable to attempt any detailed description or criticism of the mathematical chapters of this book. They are marked both by an ability and a compactness which are not surprising to those who know the character of Prof. Bryan's mathematical papers. He has had the advantage of help from Mr. E. H. Harper and other gentlemen, to whom due acknowledgment is made, and by whom the whole of the formulæ have been checked. Prof. Bryan hopes that the formluæ are correct, but modestly adds:—"It is impossible to be too careful in a matter where a mere slip of a sign might change stability into instability." Readers are, therefore, invited to check the formulæ for themselves—an invitation which may have an attraction for mathematicians, but not for all who will study the results recorded in these pages.

The volume is admirably produced, and it constitutes a valuable addition to the series of "Science Monographs," to which it belongs.

Special interest now attaches to the subjects treated;

and, in addition, it may be hoped that the wish expressed by the author will be fulfilled, and that the book will be used as a text-book for students of mathematics and physical science in the universities.

W. H. W.

STAMMERING.

The Real Cause of Stammering and its Permanent Cure: a Treatise on Psycho-Analytical Lines. By A. Appelt. Pp. ix+234. (London: Methuen and Co., Ltd., 1911.) Price 3s. 6d. net.

MANY theories have been advanced to explain the distressing complaint known as stammering, and the modes of treatment have been equally numerous. The treatment has often fallen into the hands of quacks, who have pursued empirical methods without any insight into the real nature of the affliction. The author of this book suffered during his early youth and manhood; he put himself under the care of specialists, and he was an inmate of three institutions; but the result was only failure and relapse. He now considers himself to be completely cured by a method entirely different from that usually followed, and he gives the result of his investigations and experience in this interesting volume.

The subject is introduced by a concise historical account of the notions that prevailed for centuries as to the cause of stammering. The Jews, the Greeks, and the Romans paid much attention to impediments in speech, but it was not until the sixteenth century that a real beginning was made by special observations by some of the early physicians. From that time much has been written and many theories have been advanced. The articulating mechanism was held to be at fault; weakness of the soft palate; defective movements of the tongue; abnormal movements of the larynx; spasm of the glottis, all received blame. The discovery of reflex action, about 1841, led to the view that stammering was due to a reflex spasm caused by excito-motor spinal action predominating over cerebral activity. Cerebral congestion, spasms of the vessels in the brain, intense emotional excitement, insufficiency and irregularity of respiration, and abnormal nervous irritation were adduced as explanations. It is dreadful to realise that some of these erroneous theories led to severe surgical operations, such as cutting through the base of the tongue, and it was not until 1851 that surgical treatment was abandoned as worse than useless. The view that the impediment existed in the outer organs of speech was at last definitely abandoned, but it was only since the beginning of the present century that investigators have come to the conclusion that stammering is a psychical ailment, and that the special cause is a feeling of dread, "the dread of speaking," and that to effect a cure the psychic influences or impulses must be met by counteracting suggestions.

The author gives a very interesting account of the mechanism of speech, not in the ordinary sense, but of the origin of the art of speaking in the child. Nowhere have I read a better account of how baby is influenced in the production of vocal sounds by feelings of comfort or the reverse, of how he hears his own voice, and associates the sounds with those feelings; and so on, step by step, until the sounds express ideas which are associated with baby himself, or with his parents, or those about him. There is then a full account of the pathology of stammering, and it is shown how all the irregular movements are preceded by a feeling of dread. The stammerer dreads the effort, and the greater the dread the worse the stammering, until, in extreme cases, there is positive mental torture, which reacts on the psychological condition of the sufferer, and may even alter his character. It is remarkable that there is no spasm of the glottis: "the closure of the glottis ceases instantaneously when the stammerer gives up his intention to speak." In this otherwise excellent description the author uses the word "anelectrotonus," but as this word has a very definite meaning in electro-physiology, it would be better to avoid its use as applied to the phenomena described by the author. The author also often describes affections of "nerves" when he evidently means "nerve centres." Nerves are conductors; the intimate phenomena of nervous action take place in the collocations of nervous matter we call "centres," although it must be confessed we know very little about the phenomena occurring therein.

The author then comes to the essence of his theory, namely, that stammering is essentially a psychic disturbance. At the root of speech lie the emotions; the results of emotional states may remain long in a hidden condition, or are awakened only now and then. Such emotional conditions may be repressed, and from the days of infancy they are habitually repressed. Thus we may consider them to be in a state of tension, and this tension may disturb the centres for speech, if it is associated with feelings of dread. These feelings of dread may have first originated in childhood, and for years they may exist in the mind unconsciously. The author holds strongly the modern view of unconscious mental operations that develop into a second, and usually hidden, self. This implies that there may be *mental* operations without consciousness. With this modern view I cannot agree. It is not necessary for me, however, to state my objections here, but rather to give a fair account of the author's view, which he regards as the kernel of his theory. This unconscious mind is a psychic complex endowed with extremely intense emotions and inhibitions. The individual is under its influence, and "the physical and psychic symptoms of defective speech are merely projections of the conflicts piled up in the emotional complex." The unconscious psychic complex is often in conflict with the conscious ego, and a feeling of dread, of dread of the unknown and mysterious, more than simply a feeling of fear, precedes the articulatory disorder.

This psychological view leads to a rational therapeutics. Abandon exercises in elocution; give up the dreaded pronunciation of certain words; try the effect of auto-suggestions, such as "I shall get over this and soon be quite well"; submit to hetero-suggestions of the same kind originating in the teacher or trainer, in whom the

patient should strive to have confidence; cultivate mental ease; get into a stoical frame of mind, and speak slowly, even with a drawl, as if it did not matter in the least how or what was said. Finally, the teacher employs the methods of psycho-analysis by which the modern psychologist obtains an insight, as it were, into the work of the patient's faculties. Thus by the method of Jung of "stimulus words" awakening ideas, mental "blocks" may be discovered; there is loss of time in certain mental efforts, and the hidden cause of "dread" may be discovered, although the cause may have been repressed since childhood. When the dread is removed, and a feeling of calmness predominates, then stammering disappears, never to return. Such is Mr. Appelt's interesting tale. Some of it is hard to understand, more especially his view that ill-defined but repressed erotic elements originating in childhood enter into the condition, but one feels that inquiry is on the right road, and that psychologists, as well as those who endeavour to help the stammerer, are indebted to Mr. Appelt for a very valuable and suggestive book, bearing not only on stammering but on obsessions and neuroses of many kinds.

JOHN G. MCKENDRICK.

BLACK AND WHITE IN SOUTH-EAST AFRICA.

Black and White in South-East Africa: a Study in Sociology. By Maurice S. Evans, C.M.G., with a preface by Lieut.-Colonel Sir Matthew Nathan, G.C.M.G. Pp. xviii+341. (London: Longmans, Green and Co., 1911.) Price 6*s.* net.

THE title of this book is a little misleading, as it may induce the reader on the look-out for information to conclude that it describes the negroes and the white men of the province of Mozambique, or rather of all that portion of Portuguese Africa which lies to the south of the Zambezi and to the east of the British territories. As a matter of fact, it is concerned mainly with the people of Natal, and less closely with the natives of Basutoland, Cape Colony, and the Transvaal: with South Africa proper.

Reference has been made in other reviews by the present writer published in NATURE to the unauthorised variants of accepted names introduced by writers not at present entitled to an overriding authority. This trait reappears in Mr. Evans's book in one or two instances, but most notably in the tiresome form of Abantu, with which he replaces the widely used term Bantu, that for something like half a century has been employed to indicate the racial or linguistic type of all the negroes of South Africa except the Hottentot and Bushman. Apart from the fact that Bantu has been accepted in this corollary by all the civilised people of the world, and almost the entirety of writers on Africa in general, and South Africa in particular, the substitution of Abantu is foolish and unmeaning. It simply means, in native parlance, "*the* Bantu," the *a* before the *ba* prefix being merely the fragment of a definite article which is absent from many Bantu languages, and when present is employed or not, according to the needs of the syntax. Pedantic as it may seem, it is necessary to pounce on this misuse of Abantu, because not a few reviewers who have dealt with Mr. Evans's interesting book have regarded his version as being something new and singularly correct.

It is curious how nearly all writers on South African subjects have little or no acquaintance with the rest of Africa, and often entirely misunderstand the proper application of this term Bantu. It was devised by the late Dr. W. I. Bleek as a convenient word to indicate those tribes and nations of negroes who spoke prefix-governed languages, of which the very term Ba-ntu ("men") was an effective illustration. Subsequently a Bantu physical type was alluded to by many writers on Africa, but it has since been shown that in strict accuracy it is quite impossible to associate exclusively any one differentiated type of negro or negroid with the speaking of Bantu languages. These languages, undoubtedly due in their inception to some invasion or impulse of the white man in North Central Africa some thousands of years ago, may be, and are, spoken at the present day by negroid giants and ultra-negro pygmies and forest tribes, by people of semi-Bushman race, and by others with a strong infusion of the Nilote, the Hamite, or the Semite. In no sense whatever—language, physique, folklore, traditions, customs—are the negroes of South Africa—Kafirs, Zulus, Basuto, Mashona, &c., set apart or distinct from the negro tribes and peoples over the whole rest of Africa, and the sooner South African statesmen realise this—namely, the absolute oneness of the negroes south of the Zambezi with the negroes north of the Zambezi, the better for their shaping of an intelligent, a humane, and a practical native policy. If South Africa is Bantu, so are Uganda, the Congo Basin, Angola, Zanzibar.

All who are sincerely well disposed towards the South African negroes and yet at the same time not mere sentimentalists, but practical persons, neither undervaluing the white man nor his great importance in the future development and civilisation of Africa, will welcome this book by Mr. Evans. It seems to the reviewer an accurate and perfectly fair-minded statement of the black and white problem in British South Africa. The book teems with shrewd observations and snapshots in words (for example, chapter vi., on the wasted labour of the black man). The remarks on the supposed danger to white women, the causes of such danger as really exists, and the remedies, are well worthy of study by politicians and philanthropists; so are the remarks on the unrestricted supply of distilled alcohol, and on the diseases introduced by the white man. In general, it may be said that the reader rises from the perusal of this book with a feeling that of all the divisions of South Africa the one which has behaved best and most successfully in regard to the treatment of its large negro population is Cape Colony. A mistake which is frequently made by superficial writers on South African problems is to assume that Cape Colony is a white country as compared to the adjoining States of Natal, Basutoland, the Transvaal, and Bechuanaland. Such is not the case emphatically. The eastern half of Cape Colony has a very large Kafir population. At the present day there are something like 2,000,000 of negroes and 300,000 half-castes

in comparison to 700,000 pure-blood whites. So that if the Government of Cape Colony can conduct its native affairs with little or no difficulty, scandal, or injustice, the same thing ought to be possible for the Transvaal and Natal.

H. H. JOHNSTON.

ENCYCLOPÆDIC PHOTOGRAPHY.

Cassell's Cyclopaedia of Photography. Edited by Bernard E. Jones. Pp. viii+572. (London: Cassell and Co., Ltd., 1911.) Price 10s. 6d. net.

THE encyclopædic arrangement has both advantages and disadvantages. One important advantage is the possibility of including out-of-the-way matters that could scarcely be referred to in a systematic treatise without devoting an unjustifiable amount of space to their consideration. The editor has made the very most of this possibility, for we find such headings as "Bicycle" and "Contact Breaks," the connection of which with photography is rather remote, and others, such as "Tea-tray Landscapes" and "Thought Photography," which must occur very rarely indeed in photographic or any other literature. Of the few headings that we have sought for to test the inclusive character of the volume, the only ones that we fail to find are "Metallography," a common enough word that stands for a very important branch of photography at the present time, and "Rainbow," to which the reader is specifically referred at the end of an article on "Cosmical Photography."

An advantage often claimed for the alphabetical arrangement is facility of reference, though this can scarcely be greater than in the case of a treatise with a good index. The editor appears to have been unduly anxious with regard to this matter, for in some cases he has, in our opinion, failed by reason of the excessive subdivision of the subjects. For example, some shutters are described under the heading "Shutters," where we expected to find the whole subject treated of. But other shutters are given under "Flap Shutter" and "Focal Plane Shutter," and before we get all that is given on this subject, we must read also the various sections, "Instantaneous Shutters," "Shutters, efficiency of," "Shutters, testing," and possibly others that we have not come across. And this is not exceptional, for spectroscopy appears to be distributed among nearly a dozen headings, and astronomical photography and the use of polarised light, among other subjects, are similarly subdivided.

The editor has been perhaps rather too ambitious, at least in his preface, for he refers to the volume as "surveying the whole field of photographic knowledge," and being "at once authoritative and complete." The work "is intended not only for the practical photographer, but also for the scientific student" who will find articles "valuable, because authoritative." "The manufacturer, too. . . ." The authoritative character of an article depends upon the author and upon him alone, and the real student always desires to know upon whose authority the statements that he reads depends. A very few articles are signed, but there are many and among them very excellent articles that are not only not signed, but to the authorship of which there is no clue, even in the list of chief contributors and the nature of the subjects with which they deal. The authorship in some cases is obvious enough to those acquainted with photographic literature, and some of the articles would have gained rather than lost by having their source clearly indicated.

When a volume is written by nineteen "chief contributors," and presumably other contributors in addition, it is impossible that its sections shall be equally "authoritative," and, as a matter of fact, they are of very various degrees of merit. Many are all that could be desired within their limits, giving a concise, clear, and inclusive summary of the subjects with which they deal. But in some the subject is evaded, as in "Shutters, testing," where, after a quarter of a page of information, we read that "there are numerous other methods, most of which, however, call for special apparatus," and the reader is left in the dark with regard to these "numerous other methods." Some are obscure, and we doubt whether Mr. Dallmeyer himself would have recognised the "Adon" lens that he invented from the description given of it. "Polarisation" is defined as "The splitting up or division of a ray of light into two distinct refracted parts," and here the student is left to ponder the matter with no diagram to help him, though there are "hundreds of line drawings in the text" (as stated on the title-page), and some, such as those of a "porcelain evaporating dish" and a "clamp for general use," might well have given place to others more helpful. As might be expected, the volume is not free from errors. Cedar-wood oil is not volatile; the Abbe two-lens condenser is not of low numerical aperture; and it is not correct to say that "the focal lengths of the microscope objectives in general use range from 3 in. to $1\frac{1}{2}$ in.," even if we add that "lenses of both lower and higher power are manufactured." We do not understand how a photograph taken on an isochromatic plate with a "six-times" yellow screen can be "over-corrected," nor how "beads of dried paste, made with magnesium powder and distilled water," could be used instead of limes for the limelight. But looking at the book as a whole we can safely say that the discriminating student will find in it a great fund of information, and that a reference to it will sometimes save him prolonged if not fruitless search among rare, little-known, and old records.

C. J.

MATHEMATICS FOR TEACHERS.

Lectures on Fundamental Concepts of Algebra and Geometry. By Prof. J. W. Young. Prepared for publication with the cooperation of W. W. Denton. With a note on the Growth of Algebraic Symbolism by Prof. U. G. Mitchell. Pp. vii+247. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 7s. net.

THIS book contains a series of lectures on some of the fundamental principles of mathematics, treated from the most recent and scientific point of view; that is, mainly with reference to their consistency and the nature of the assumptions involved.

The reader is not supposed to have any advanced technical knowledge, and everything seems done to help him to appreciate the important notions which the last few years have developed.

Among the subjects treated are the meaning of definitions, axioms, and postulates; the elementary properties of classes, and of transfinite ordinal and cardinal numbers; negative and complex numbers; the three possible geometries in three-dimensional space; spaces of more than three dimensions; variable, function, and limit.

As an indication of the upper limit that is reached, it may be noted that we have Cantor's proofs that the numerical continuum is not denumerable, and that the class of algebraic numbers is; correspondence between points of a line segment and those of a square; and a brief account of quaternions.

In the more strictly geometrical part, Hilbert's axioms are discussed in considerable detail, an illustration is given (after Klein) of a system for which Archimedes' axiom is not satisfied, and an account is given of Pieri's kinematical theory. This last is comparatively novel, and will perhaps appeal to some more vividly than Hilbert's.

There are a few controversial points to which attention may be directed. On p. 43 we are told that "the only test for the consistency of a body of propositions is that which connects with the abstract theory a concrete representation of it." Even allowing the widest sense to the term "concrete," this does not seem justifiable. Weierstrass proved that ordinary complex algebra could *not* be consistently extended to a linear algebra of three or more dimensions, and his proof was as abstract as possible. The fact seems to be, as Prof. Young practically admits elsewhere, that there is no absolute test of consistency for any set of assumptions; all we can say is that, after applying them in myriads of ways, we have not found any inconsistency.

Then there is the question of the term, "the class of ordinary classes" (p. 219). Prof. Young takes the view, which seems the right one, that this term is intrinsically nonsensical, and involves a vicious circle.

On p. 81 the symbol ω is unfortunately used for the *cardinal* number of all denumerable sets. It is much better to keep it as the *ordinal* number of the natural scale, and use a for the corresponding cardinal.

Finally, with regard to the author's pedagogic attitude. He emphasises rightly, more than once, that with young pupils no attempt should be made to treat the subject with logical rigour. On the contrary, a large number of assumptions will be made, and everyday experience constantly appealed to. This is a sufficient answer to those who think that the "logicians," as a body, wish to reduce mathematics to dry bones. At the same time, a teacher ought to know something about these logical methods, just in order to avoid making dogmatic assertions which have been shown to be false, and also that he may answer inquiries without implanting erroneous ideas. For this purpose Prof. Young's book may be heartily recommended; it is one more of the many good educational works on mathematics produced in the United States.

G. B. M.

OUR BOOK SHELF.

Contemporary Chemistry: a Survey of the Present State, Methods, and Tendencies of Chemical Science. By E. E. Fournier d'Albe. Pp. xvi+180. (London: Constable and Co., Ltd., 1911.) Price 4s. net.

If the author of this book had been content to give it a more modest title, the task of the reviewer would have been a pleasanter one. Mr. Fournier d'Albe undoubtedly possesses a gift of expression, and his breezy style is attractive and interesting. Moreover, due praise must be given to him for his effort to popularise the fascinating phases of modern chemistry. Yet it is just here where the difficulty comes in. If the present book is intended for the general reader, the author's semi-journalistic "lightning sketches" assume too much, and are too lacking in coherence, to convey any definite impression. On the other hand, the serious student of chemistry will find the author's fare, if appetising, rather scrappy and unsatisfying.

The book indeed fails to give any rational and connected account of the main lines of contemporary chemical science. Let us take, for example, the chapter on "Affinity," where the author gives us little more than a couple of hazardous calculations on the attraction of electrical charges. Not a word is said about the real work of to-day, namely, the numerous experimental methods of measuring chemical affinity, and the collation and comparison of the vast amount of data already obtained. We cannot have our Newton before our Tycho Brahe and Kepler.

A closer examination of the book reveals in many cases the author's want of familiarity with chemistry, whereof a few instances may be noted. On pp. 21–22 we hear about de Broglie, but no hint is given of the work of Perrin, Svedberg, or Henri. On p. 36, it is stated that "a single phase has therefore two independent variabilities." On p. 38 there is a complete confusion between passivity to change and Le Chatelier's theorem. The calculation on p. 55 appears to the reviewer to be quite absurd. On p. 56 there occurs a misleading confusion between ordinary and electrolytic dissociation, whilst on p. 57 the use of the expression "specific conductivity" instead of molar conductivity leads to dire results. P. 59 opens with the sentence, "It might seem at first difficult to prove that metallic sodium and uncombined chlorine exist in a dilute solution of hydrochloric acid." Apart from the obvious misprint, this is truly a case of "save us from our friends." The cup is full when, on reaching p. 92, the author says, "Yet to-day we believe not only that metallic sodium exists in sea water," &c. One wonders what the author's theory of the metallic state would be like. Other slips of a similar nature might be quoted, but it would be ungracious to multiply instances.

As a survey of the present state, methods, and tendencies of contemporary chemistry, the book is indeed very inadequate. But as a crisply written and readable sketch of many interesting things it may stimulate interest where many a more ponderous and more accurate volume would fail.

F. G. D.

Outlines of Biology. By Dr. P. Chalmers Mitchell, F.R.S. Revised and supplemented by George P. Mudge. Third edition, revised. Pp. xv+348. (London: Methuen and Co., Ltd., 1911.) Price 6s. net.

This is a book which, as its author and reviser say in their opening remarks, is intended to "cover the ground of the student working for the First Examination of the Conjoint Board of Surgeons and Physicians, London," and also as an elementary text-book for

"those who propose to devote themselves afterwards to more detailed study of zoology."

There has been for a considerable period a great need of a suitable text-book of biology for the First Conjoint Examination, as the authors of elementary text-books seem invariably to base the contents of their volumes on the syllabus of the examinations of the University of London. It is thus with considerable pleasure that we welcome a text-book that we can put into the hands of students, feeling confident that it will neither burden their minds with unnecessary matter, nor fail to deal with subjects coming within the range of their examination.

Almost the whole of the book deals with the types required by the Conjoint Board; the remaining chapters contain either accounts of a few other organisms, which the authors consider necessary for the proper comparison of the types, or else they set forth in an elementary manner some of the general principles of biology. In one or two matters the reviewer does not see eye to eye with the authors. In some minor theoretical points they adopt views divergent from his. For instance, they unequivocably describe bacteria as unicellular plants, while the extremely primitive organisation and their peculiar and equally primitive methods of nutrition justify, in our opinion, their classification as a group entirely apart from animals or plants, and certainly lower than the typical unicellular organism. Another point is the complete separation of blood from the other connective tissues in a group of its own. But, after all, these are matters of opinion and not of fact.

A more serious matter is the fact that all the figures, with the exception of the plates, have been ruthlessly diagrammatised. We feel that whatever these figures gain in clearness from this simplification they will lose far more in usefulness when the student attempts to apply them to the actual specimens. We hope, however, to see this remedied in future editions, and with this exception, and in spite of it, the book is one that should prove of value to the students to whom it is addressed. R. W. H. R.

The Boy Fancier: being a Complete Manual of all Matters Appertaining to Domestic Pets Suitable for the Youthful Fancier. By F. T. Barton. Pp. xx+435. (London: George Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 5*s.*

FROM his professional training as a member of the Royal College of Veterinary Surgeons, the author of this well-illustrated volume is thoroughly qualified to give sound and trustworthy information with regard to the general care, feeding, and treatment in illness of animals kept as pets, or, like poultry and goats, reared for profit. And although the work before us is primarily intended for the benefit of young persons, it will be found equally valuable for those of more mature age, who, for purposes of pleasure or profit —or both combined—devote their attention to the keeping and rearing of dogs, cats, goats, guinea-pigs, rabbits, squirrels, poultry, pigeons, cage-birds, &c.

In the case of dogs Mr. Barton refers particularly to such as are best suited for boys, especially those adapted for ratting and rabbiting, and gives valuable advice to his young readers in the matter of proper training. Guinea-pigs he regards as specially suitable for children, since they require much less care and attention than rabbits. The sections on poultry and pigeons, as well as that on goats, will be found valuable to older readers, as most of the more important breeds are more or less fully mentioned. The book may be confidently recommended as one of the best of its kind, the only error that has come under our notice being that the habitat of the capuchin monkey is given as Guinea, instead of Guiana, which is obviously a mere misprint. R. L.

Methodical Nature Study. By W. J. Claxton. Pp. 195. (London: Blackie and Son, Ltd., 1911.) Price 6*s.*

THIS book is framed with the object of indicating a series of lessons on plants and animals, appropriate to each month in turn, so that the qualification "seasonable" would be more applicable than "methodical." The author has found it difficult to maintain the study of animals throughout the winter months, and in some instances reverts to lessons based on pictures or to instruction without observation. The botanical syllabus follows very ordinary lines, but there is a notable omission of physiological experiments. The author is not sufficiently careful in his use of technical terms, as will be evident from a reading of p. 16; nor can his reasonings be freely accepted. There are many excellent illustrations from photographs by Charles Reid, Henry Irving, and Douglas English, which, however, are shorn of their value in a book concerned with the study of nature by direct observation.

Geological and Topographical Maps: their Interpretation and Use. A Handbook for the Geologist and Civil Engineer. By Dr. A. R. Dwerryhouse. Pp. viii+133. (London: Edward Arnold, 1911.) Price 4*s.* 6*d.* net.

THE practical problems involved in the interpretation of geological and topographical maps are here dealt with in a manner likely to appeal to students of geology and civil engineering. Having worked his way through the book, a student should be able to draw sections of the country shown upon a map, to estimate the thickness of the strata of which the area is built, and to understand the relations of the strata to the surface of the ground and to each other.

The volume is illustrated by ninety clearly drawn figures, and tables are provided showing variation of dip and the natural sines, tangents, and cotangents. Some typical exercises to enable the student to test his knowledge would be a useful addition to the next edition.

Flora of the Upper Gangetic Plain, and of the Adjacent Siwalik and Sub-Himalayan Tracts. By J. F. Duthie. Vol. ii., Plumbaginaceæ to Plantaginaceæ. Pp. ii+266. (Calcutta: Superintendent, Government Printing, India, 1911.) Price 2 rupees (3*s.*).

THIS volume treats the second and third series of Hooker's Gamopetalæ. The order Ericales is wanting from the flora; otherwise twenty-six out of thirty families are represented. There are three large families, the Acanthaceæ, Labiatæ, and Scrophulariaceæ; paucity of species is very noticeable, and many genera are unispecific; Ipomœa is the chief exception, as it supplies twelve indigenous and seven important cultivated species. Several changes are made in generic nomenclature from that followed in "The Flora of British India," such as the segregation of Ipomœa into four species; these changes are noted without the comment that one would have expected. Very few indigenous species in these series are of much economic importance. *Diospyros tomentosa* supplies the ebony of northern India; *Tectona grandis* is described as native; *Sesamum indicum* is cultivated, but not to any great extent.

Memories of a School Inspector. Thirty-five Years in Lancashire and Suffolk. By A. J. Swinburne. Pp. 274. (Snape Priory, Saxmundham: Published by the Author; London: M'Dougall, n.d.) Price 2s. 6d. net.

THIS story of thirty-five years' work as a Government inspector of elementary schools is concerned chiefly with anecdotes of encounters with a great variety of characters. Educational questions of importance are touched upon lightly here and there, but the object of the book appears to provide entertaining reading for leisure hours.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Microscope Stands.

MICROSCOPISTS will have experienced a feeling of satisfaction that, what they might anticipate would be a carefully reasoned consideration of the respective merits of Continental and English microscopes, had been provided for them in the issue of NATURE of December 21 last, but their satisfaction must have been considerably modified when they had finished reading the article in question. The subject is admittedly one of considerable difficulty, but no good purpose is to be served by giving the opinions of those, if one may judge from the opinions expressed, who are only able to see from the point of view of the producer, the user not being considered. Apparently the intention is to state the matter from each side: the first and second sections, therefore, treat of the characteristics and advantages of the English and Continental types respectively, while the third and concluding section would presumably be a careful comparison of these two types. In point of fact, the latter is nothing but a eulogy of the productions of Continental houses, and, if the concluding sentence is to be accepted, there is nothing left for English producers but to retire from the field and leave them in undisputed possession.

The opening statement of the claims for superiority in the English stand is fairly set out; in fact, as no particular opinion is expressed on the merits or demerits of this type of instrument other than to indicate its good points, little can be urged against it. The controversial part is mainly confined to that in which the provision of sprung bearings and controlling screws is set forth as an advantage, but I shall have occasion to refer to this further when considering the claims of the Continental type.

The second part of the article is headed "A Defence of the Continental Form." The first point raised, that the short Continental microscopes are more convenient in use, applies only when the instrument is used in a vertical position: but it should have been pointed out that this shortness is dependent on the optical tube length, which is shorter than in the English type.

The mechanical stages on the best Continental stands are all that could be wished, and the claims made under that head are quite justifiable.

The substage arrangements might easily be the subject of criticism, as in most Continental types they are far too cramped, and there is not sufficient latitude to allow of the easy manipulation of the various substage fittings. At the same time it must be admitted that in all but a very few cases a fine adjustment motion to the substage fittings is not necessary. But this is not because the Continental types are of necessity better made, as the paragraph in question somewhat implies, but because, in general, an achromatic condenser, even of the finest optical construction, does not focus within such narrow limits that a fine adjustment motion is necessary. A well-made rackwork will, in fact, give a sufficient degree of accuracy.

As to the horseshoe foot, this has little to recommend it when compared with the English tripod. It is true that there are three points of support, but they are not sufficiently far apart, and are not in the position in relation to the centre of gravity to ensure rigidity and firmness in any position. For photomicrography no well-designed stand should require clamping to its base at all, and the best of Continental microscopes, even those especially designed for the purpose, are so unstable that they will not stand alone when horizontal, much less retain any degree of stability in that position. The method of clamping down is usually such that the instrument is under considerable strain and tension, and certainly should any vibration be set up it will feel the effects of this to the utmost. The statement that clamping down is necessary with the larger stands of English make is not in accordance with the facts; I have recently had a microscope made by a leading English maker which is even more stable in the horizontal than the vertical position, and I should certainly consider that any clamp when using this instrument would be superfluous.

The large body tube of the Continental stands is a point distinctly in their favour, and one which some English makers have wisely thought fit to imitate.

As to the sensitiveness of the fine adjustment, this is perhaps a controversial point, the degree of sensitiveness required depending to a large extent on the user. As one becomes more expert, it is realised that such extreme slowness of movement is not required, but that it is necessary for the movement to be absolutely precise. Slowness of the fine adjustment motion which is claimed as a characteristic of the Continental type has at least been equalled for many years by an English maker. One well-known English fine adjustment moves the body tube 1/25,000th of an inch per division of the milled head, and this is practically the same as that provided in one of the newest of Continental instruments.

As to the relative merits of ground-in as compared with sprung motions, there is no doubt, from the point of view of the ordinary microscope user, that the ground-in fittings are preferable, but this does not of necessity apply to those who use their instruments with great care and who are quite capable of making the necessary adjustments which the sprung fittings provide. When once a ground-in fitting has become loose from wear there is nothing to do but to return it to the maker for replacement, whereas with the sprung fittings, by careful use, they can be adjusted from time to time and the instrument kept in perfect working order. However, this point has been more or less settled in favour of the ground-in method, as leading English makers are now providing (and some of them have done so for several years) instruments in which all their fittings are ground. So far, the respective claims of the English and Continental stands are fairly well set out, although much of the information given is to be found in makers' catalogues; but it is when we come to that part of the article headed "English and Continental Microscopes," and in which, therefore, we look for a careful comparison of the merits and demerits of the two types, that astonishing claims are made. While it is scarcely possible to consider fully the question of the evolution of the microscope, it must at once be said that the statements made are not strictly in accordance with the real facts.

The modern Continental microscope, whatever its advantages or disadvantages, has been evolved largely as the result of a consideration of the English model. Here we are told that the present-day English microscope is a degenerate form of what was originally a complicated and massive piece of mechanism, the multiplicity of racks and screws of which were a source of delight to *dilettanti*, while the modern Continental instrument is an evolution from an exceedingly simple, and by inference highly satisfactory design. To put it plainly, this is not the fact; the refinements on a modern Continental stand have almost entirely been borrowed or copied from more perfect English models. We are told that the serious worker in science has not the time to play with the large variety of fittings in the English stand, while the *dilettante* is content to manipulate these with the result that he is both "physically and mentally exhausted." In any case, if the user of a microscope requires an instrument that will deal with a large number of objects in a given time, it would be quite easy to devise some mechanical arrangement. Fortunately, there are still

workers who would be content to observe one preparation per day if such observation resulted in their seeing something that otherwise would pass unnoticed. The multiplicity of screws and racks which are scoffed at may each perform its function, and one has yet to learn that even the most complicated English microscope that has yet been produced cannot be manipulated, and all its adjustments made use of, in as many minutes as the writer would seem to imply hours are needed for the task.

The English tripod is, however, treated with a little more fairness, and it is even admitted that this has so modified the intentions of Continental makers that they have altered their microscope base in recent years, so that it has at least some of the advantages of the English tripod form. But the statement is here again made that in photomicrography the Continental horseshoe is the equal in stability of the English type if the former is clamped down. As a photomicrographer, one can only say that it is entirely in opposition to experience, and that the horseshoe foot, in which the centre of gravity of the instrument is not in its proper position for stability, is never the equal of the English tripod, neither can it with fairness be urged that the English tripod results in less freedom of access to the substage arrangements than does the Continental type.

We come next to the paragraph in which the superiority of a centring arrangement to the objective over the method of centration of the substage is claimed, and we are told that in photomicrography the absence of centring screws in the substage means "a considerable saving of time," &c. One always understood as a question of practical optics that considerable trouble is taken by opticians to ensure that the objective and ocular are in optical alignment. We know that there is always some difference of centration between objectives even by the same maker, which is no doubt unavoidable in the course of manufacture, but these differences are but slight. In good microscopes very great care is taken to ensure that the nose-piece of the instrument is made to take an objective which, when screwed home, is as nearly as practicable in perfect optical alignment with the eyepiece. But the same cannot be said for the substage condenser. This is an independent optical system carried on a separate part of the instrument, and it is extremely difficult to ensure accurate alignment, and still more difficult to maintain this, even if it were so at the start. English microscopes are therefore provided with centring screws to the substage, and it would be interesting to hear on what optical grounds it can be proved that a method of centring the objective, in relation to an eyepiece and substage which are themselves not in alignment, can be justified. We are also told that objective changers which have centring screws provided on them are to be used and manipulated in the course of work for centration purposes. The avowed object of centring screws on these carriers has always been to provide against the slight want of centration between different objectives already referred to; but that these small fittings should be used for purposes of centration in the ordinary course of manipulation of the instrument is a purpose which has never before been assigned to them. One wonders what would be the condition of these little screws with their short bearings after a few months' regular laboratory work!

We are entitled to infer, therefore, that these Continental microscopes are so extraordinarily well and accurately made that perfect collimation of the substage condenser with the magnifying system is perpetual, which can only be described as unlikely.

As to the mechanical draw-tube (*i.e.* one with rackwork focussing), this is a feature, as stated, that is only provided in a few Continental models, whereas the English instrument of any elaboration is provided with such. But we are told that, *instead* of this mechanical draw-tube, the Continental makers provide the objective with correction collars, from which it may be inferred that correction collars are unknown in English objectives. Perhaps the writer is not aware that Messrs. Powell and Lealand fitted correction collars to their objectives some seventy years ago, and have continued to do so, and that every English house is at the present time making objectives which are provided with correction collars. As the writer evidently regards mechanical draw-tubes (and, presumably, any draw-tube at all) as an unnecessary elaboration, it would be interesting to know how he would provide against variations in thickness of cover-glass when using an objective such as a 12 mm. Zeiss apochromatic, an objective which is, rightly, not provided with collar adjustment, although its magnificent corrections are substantially affected by differences in cover-glass thickness.

As to the want of uniformity in the Royal Microscopical Society standards, the writer here has a fair cause for complaint. The society has been for some time considering the question of these standards, a subcommittee is at present dealing with the matter, and it is to be hoped that something like finality will be reached as the result of their deliberations. At the same time, it must be pointed out that the chief cause of variability is not that the society's standards are wrong, but that makers, whether English or Continental, have failed to conform to them. There is not the least doubt that the society would welcome the cooperation or the assistance of the National Physical Laboratory in this matter, as it is one not without difficulty, and the greater the weight of opinion that can be brought to bear on the subject the better.

There are still many points outstanding that one feels require further elucidation, but it is feared that the ordinary limits of a letter have been much exceeded. It is to be hoped that other microscope users will give their opinions and help to arrive at some sort of conclusion as to the respective merits of the English and Continental microscope.

J. E. BARNARD.

King's College (University of London), Strand, W.C.

The Teaching of Electricity in Schools.

IT will be seen from Mr. Daniell's report of the meeting, held on January 12, of the Association of Science Masters in Public Schools (NATURE, January 18) that the headmaster of the Royal Naval College at Dartmouth has made himself responsible for the advocacy of a complete reversal of the historical order in teaching electricity to boys. He would begin with electricity in motion, and only incidentally throw in a little parenthetic information as to the phenomena of the electrostatic field.

I gathered from Mr. Ashford's address that it is for the sake of helping young boys to a pleasing and perhaps useful familiarity with the working of such things as electric bells, lamps, telephones, dynamos, and motors that he is willing to begin the subject at the wrong end, to omit the consideration of some of the most fundamental facts of the science, to introduce terms and units of measure which must appear extraordinarily arbitrary, and the exact significance of which cannot possibly be understood, and in general to make the best he can of what is logically a very bad job. He thinks that the gain overbalances the loss. I am very strongly of the opposite opinion.

Leaving out of consideration the very special training that may be required for a naval officer, I would refer to the boys who come for a good general education to a public school, where the science teaching will be only a part of a general scheme of education. It is important that the development of a boy's intellectual powers shall proceed happily and harmoniously, that every part of the teaching shall, if possible, assist every other part. If the science teaching is less methodical, less logical, less sincere than that of other subjects, the boys will soon find it out, and the other teachers of classics and mathematics will soon find it out, with the result that the science teaching will fall into just disrepute.

I think I should prefer for a boy of my own no teaching of electricity at all rather than such illogical teaching as that advocated by Mr. Ashford.

A science master who is not developing a subject step by step in a thoroughly orderly and logical manner, proceeding from the simple to the complex, insisting on the accurate definition of every term used and on its use in that sense only, is not in my opinion taking his share in the educational scheme of which his teaching should form part.

It is, however, my experience that, provided a boy has

already a fair knowledge of magnetism, of heat, and of chemistry, he can very profitably begin the study of statical electricity, which can be made quickly to lead on by well-understood steps to the study of electric currents.

Clifton, January 22. A. M. WORTHINGTON.

Glazed Frost.

A REMARKABLY good instance of glazed frost occurred in the London suburbs on Thursday morning, January 18, and evidently the same phenomenon was observed over a wide area in the south of England. A touch of real winter had spread rapidly over the country, and a strong and cold easterly wind was blowing, associated with the European anticyclone where the barometer was 31 inches, and with an area of low barometer readings over the Atlantic in fair proximity to our coasts. These conditions occasioned a heavy fall of snow over the northern and Midland portions of England, but there was copious rain in the south of England, with the air temperature at or slightly below the freezing point.

The trees and shrubs, as well as all ornamental work, in the garden were coated with clear ice varying in thickness from a tenth to two-tenths of an inch.

I plucked a twig with its ice coating on Streatham Hill and carried it with me to Fleet Street, where on arrival an hour later the twig remained encrusted with ice.

The shrubs and wire arches, &c., were exceedingly beautiful, but there was no ice coating within 2 feet of the ground—my lowest screen temperature was 31°.

The following description of the phenomenon is taken from "The Observer's Handbook," published by the Meteorological Office, London, 1910:—

"GLAZED FROST. (German *Glatteis*, French *Verglas*.)

"A transparent *smooth* coating of ice covering trees, buildings, &c. The phenomenon is usually caused by rain which freezes as it reaches the ground, and thus covers all objects with a coating of smooth transparent ice. It is very rare in our climate, but on the Continent or in America it is more common. The weight of the ice which collects is frequently sufficient to cause damage to telegraph wires, trees, &c. It is probable that the rain in these cases consists of supercooled drops of water."

Scott's "Elementary Meteorology," p. 116, has an excellent reference to a remarkable instance of glazed frost which occurred in France on January 22–24, 1879, taken from the *Comptes rendus* of the Paris Academy of Sciences. CHAS. HARDING.

The Isothermal Layer of the Atmosphere.

MAY I be permitted through the medium of your columns to suggest briefly what appears to me a possible explanation of the isothermal layer of the atmosphere, or stratosphere?

It is, I believe, generally admitted by astronomers that the swarm of small cosmical bodies reflecting light from the sun, known as the Zodiacal Light, extends beyond the earth's orbit, but lies outside the earth's atmosphere. My proposition is that heat received by these bodies from the sun is reflected, some of the heat reaching our atmosphere and penetrating its layers as far as the outer limits of the cloud layer. The heat thus supplied from above would be supplemented by heat received through the agency of terrestrial radiation, a larger supply being accumulated above the land than above the ocean. The greater height of the isothermal above the latter might be accounted for in this manner.

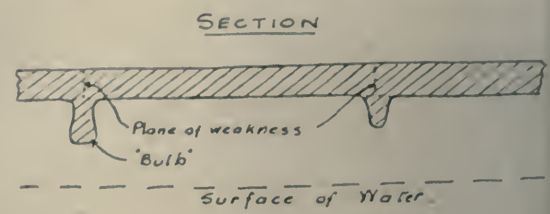
This suggestion is thrown out for the purpose of eliciting criticism, and in the hope of gaining information.

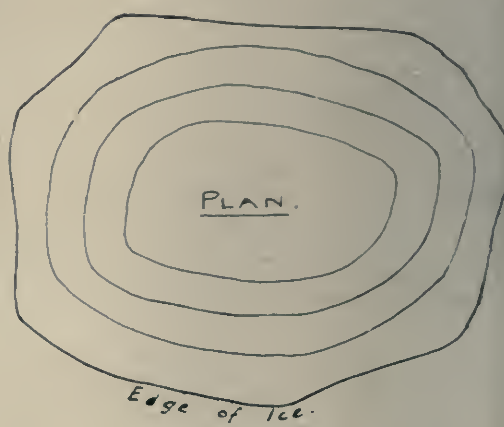
CAMPBELL HEPWORTH.

2 Amherst Road, Ealing, W., January 15.

Concentric Joints in Ice.

IN walking over a piece of water-logged ground, I noticed several small shallow pools which had frozen over. A number of rings, more or less parallel to the edges, were visible as in the plan. The water was found to be a couple of inches below the top of the ice, and the rings were vertical planes, along which the ice could be readily broken. Beneath each of these concentric "joints" the bulb formation indicated in the section (roughly to scale) was found in various stages of development, the bulbs nearest the centre being, as a rule, the most perfectly developed. The full bulb projected about three-quarters of





an inch below the ice-sheet, which did not vary much from five-eighths of an inch or so in thickness.

I should be interested to hear if any of your readers can explain the somewhat peculiar formation described above.

HAROLD J. F. GOURLEY.

St. Stephen's House, Victoria Embankment,
Westminster, S.W., January 15.

The Late M. Radau.

IN the obituary notice of M. Radau printed in the "Notes" columns of NATURE (January 11, p. 354) I notice the statement: "At no time does he seem to have held an official post as a practical astronomer." These words fail to do complete justice to this distinguished man of science. On M. Loewy's death M. Radau was appointed to succeed him as "le Membre du Bureau des Longitudes chargé de la rédaction de la Connaissance des Temps," and in this capacity he signed the "avertissements" to the volumes of the Connaissance des Temps for the years 1911, 1912, and 1913 as the official responsible for their contents.

January 20. A. M. W. DOWNING.

The Luminosity of Cats' Eyes.

I HAVE repeatedly observed the brilliancy of cats' eyes in the dark in particularly favourable circumstances. I have a brilliant incandescent light in my hall, and several cats on the premises. The entrance drive is in a line with the door and the hall lamp. When I call a cat in the chances are that if there she simply sits and looks at me presenting the spectacle of two small incandescent lights glowing out of the darkness. Light, observer, and cat are all three in line, as observed by Colonel Herschel.

A. R. HUNT.

Southwood, Torquay, January 23

GROWTH AND SHRINKAGE OF GLACIERS.[1]

THE volume referred to below deals with certain glaciers in Savoy; four of them in the *massif* of Mont Blanc, the same number in the Maurienne, and one in the Tarentaise. It is well known that, during the last few centuries, the Alpine glaciers have been increasing and decreasing in volume, though the extent and duration of these oscillations have been less certain, and observers in different parts of the chain are now watching and recording the amount of changes. The glaciers near Chamonix are particularly well adapted for study, because that place has been frequented by travellers for a longer time than other Alpine centres. Hence more information can be obtained, and this in some cases is supplemented by drawings, which, however open to criticism as works of art, are valuable records of facts.

FIG. 1.—Glacier du Tour, October, 1891.

These Savoy glaciers attained one maximum, according to a curious contemporary record, in 1643; they had greatly dwindled in 1770, but during the next ten years they again increased. Early in the next century came another advance, which culminated in 1819, and was followed by another retreat. They again advanced in 1826, and oscillated considerably during the next ten years. In the latter part of this century the Chamonix glaciers apparently did not diminish so much as those in most other parts of the Alps; for they are said to have ceased shrinking in 1875, and to have reached another maximum (though smaller than on some previous occasions) in 1892.

The French surveyors have worked on a definite and comprehensive plan, making maps, fixing points for measurement and observation, and taking photographs, so that a precise register, from year to year, can be kept of the changes in these ice-streams. Some old illustrations have been reproduced, which, though artists might justly criticise, give us a good notion of the state of certain glaciers about the maximum of 1832, and photographs show some of the changes during the last twenty years. Those, for instance, of the Glacier du Tour in 1891 and 1898 (Figs. 1 and 2) indicate a considerable alteration in the volume of the ice; for an ice fall has shrunk enough to disclose a large part of the cliff by which it has been produced, while a third view, taken in 1907, exhibits a still larger amount of bare rock. It is also worth observing, though we must not enlarge upon so controversial a subject, that these illustrations have a bearing on the question of the erosive power of ice. They indicate (and this is corroborated in other parts of the Alps) that a glacier in passing over a well-marked step of rock often neither smooths it away nor digs for itself anything like a deep channel.

The position of the glaciers treated in this work has been, so far as possible, ascertained and recorded, the method of studying them being described and worked out in a typical case, so that students of glaciology receive a valuable addition to the facts at their command, and their successors, in another half-century, will be in a far better position to ascertain the precise causes of these ebbs and flows in the ice-streams of the Alps. A sentence on the title-page of this book is significant, "Service des grandes Forces hydrauliques," for it shows that the French Government (the work is undertaken by the Ministerial Department of Agriculture) recognises the value

FIG. 2.—Glacier du Tour, October, 1898.

[1] "Études Glaciologiques en Savoie." Tome ii. (Ministère de l'Agriculture. Direction de l'Hydraulique et des Améliorations Agricoles. [Service des Grandes Forces hydrauliques, Région des Alpes.) Pp. vii+140+19 plates. (1910.)

of Alpine rivers as inexhaustible stores of energy. Had we the same in Britain we could contemplate with equanimity the exhaustion of our coalfields.

T. G. BONNEY.

CELESTIAL SPECTROSCOPY.[1]

THE publication referred to below contains an account of six separate and distinct investigations, which have been grouped together under the above heading. In part i. are given the results of a comparative study of the sun (Fraunhoferic), chromosphere, and lower type star spectra in relation to the sun-spot spectrum. Part ii. contains an account of an investigation into the spectrum of ε Ursæ Majoris as compared with the normal Sirian spectrum. Under part iii. is found a discussion of the occurrence of nitrogen lines in the stellar spectra, and under part iv. lists of the enhanced lines of certain metals, which have not previously been published. The wave-lengths of certain well-defined lines of simple and definite origin, which are peculiarly suitable for radial velocity measurements, are given in part v., while under part vi. are grouped the wave-lengths of those well-marked lines occurring in celestial spectra for which no terrestrial equivalents have yet been found.

It may be said at once that the two last sections of this book should prove of great value. It is manifestly impossible to obtain accurate results in any radial velocity measurements unless the selected spectrum lines are at once simple in structure and of known origin. The publication of a list of such lines occurring in the spectra of nine different types (Kensington) must certainly aid those engaged in this particular branch of stellar spectroscopy.

The first part of the book is devoted to a comparison between the sun spectra and those of Capella and Arcturus, considered especially in reference to the spectrum of sun-spots. Certain of the Fraunhofer lines are found to be considerably modified in intensity in the Arcturus spectrum, and it has been definitely established by Hale and Adams that the same lines are affected in sun-spots. A close comparison of the Kensington measurements with those taken at Mount Wilson is given as far as they overlap, and though there are present in each certain lines not common to both, the two sets of observations are strikingly concordant. It has always been held by Sir Norman Lockyer and his co-workers that the comparison between the spectra indicate that the temperature of Arcturus and that of the sun-spots are comparable and lower than that of the rest of the solar reversing layer. Although other theories have been advanced, the latest observations go to show that the Kensington theory is the right one.

The second chapter deals entirely with the spectrum of ε Ursæ Majoris, the lines of which have been measured and as far as possible traced to their origin. The differences between this spectrum and those of Sirius and α Cygni are given, and the general conclusion is drawn that ε Ursæ Majoris must be placed between the Sirian and the Procyonian group on the Kensington temperature scale.

It is impossible in a short notice to enter into the details of this work, so many branches of which have been grouped together. Suffice it to say that the whole investigation stands on the same high plane as all those carried out in the Solar Physics Observatory, and the author is to be congratulated on bringing a laborious research to a successful conclusion.

[1] "Researches on the Chemical Origin of Various Lines in Solar and Stellar Spectra; being the Results of Investigations made at the Solar Physics Observatory, South Kensington, after discussion." By F. E. Baxandall. Pp. vii+77. (London: H.M. Stationery Office, 1910.) Price 4*s*. 6*d*. (Solar Physics Committee, under the Direction of Sir Norman Lockyer, K.C.B., F.R.S.)

"YELLOW JACK."[1]

A MELANCHOLY interest attaches to this volume inasmuch as it was the last work penned by its gifted author before his premature decease, and serves to emphasise the loss to tropical medicine sustained thereby.

The book is a complete treatise on yellow fever—the "yellow jack" of the earlier navigators, that dread disease which so often broke out with appalling suddenness and severity on ships voyaging to the west coast of Africa, the West Indies, and Central America, and parts adjacent thereto. Its distribution is somewhat peculiar in that it is practically confined to that part of the globe between the parallels of latitude 40° north and south, and of longitude 20

FIG. 1.—*Stegomyia fasciata*, F. (=*Calopus*, Mg.), ♀, the mosquito which carries yellow fever. From "Yellow Fever and its Prevention."

east and 100° west. It is true that outbreaks of th disease have occurred somewhat outside these limi *e.g.* in North Italy, French seaports, Swansea, an Southampton in this country (a few cases only), an at times severely in New York and Philadelphia, bu in these districts it has never obtained a foothol The reason for this geographical distribution is ass ciated partly with the endemic areas which natural exist in West Africa and Central America, and part by reason of the fact that the disease is transmit by a species of mosquito, the *Stegomyia fascia* (*calopus*), the distribution of which is practical world-wide *between* the parallels of latitude 40° nor and south. Thus in Europe, the Stegomyia is fou in southern Spain, Italy, Malta, and Greece, and

[1] "Yellow Fever and its Prevention: a Manual for Medical Students a Practitioners." By Sir Rubert W. Boyce, F.R.S. Pp. xv+330. (Londo John Murray, 1911.) Price 10*s*. 6*d*. net.

occurs outside the epidemic and endemic areas of yellow fever in East Africa, Arabia, India, Indo-China, China, Japan, the East Indies, Australia, and some of the Pacific Islands. It may be asked, how is it that yellow fever is not a disease of the last-named countries? The reply is because the disease has never been introduced into them, and epidemiologists are keenly alive to the fact that the conditions existing therein are probably just as favourable for its spread there as in the localities in which it exists. Should the disease ever be introduced into the East, and increasing facilities and rapidity of travel are favourable for such an event, the consequences probably would be disastrous. The impending opening of the Panama Canal, for instance, is recognised as a menace to China so far as the introduction of yellow fever is concerned, and efficient precautions will doubtless be taken to prevent such an occurrence.

The various subdivisions of the book deal respectively with the history and geographical distribution of yellow fever, its symptomatology and treatment, pathology, epidemiology, entomology, and prophylaxis. While forming a treatise for the use of the medical and sanitary office, its style is such that it can be understood by any educated individual, and should thus be of service to Colonial governors and members of legislative assemblies and municipalities of localities where the disease may occur. The author considers that yellow fever is an endemic and indigenous disease of Central, and the northern part of South, America, of the West Indies, and of West Africa, and a record is given of the principal outbreaks occurring there and in other parts during the past two centuries.

FIG. 2.—A row of upturned bottles used to make an edge to a flower-bed in Freetown, Sierra Leone. Favourite receptacles for Stegomyia larvæ. From "Yellow Fever and its Prevention."

The portion of the book which will probably appeal most to the general reader is that dealing with prophylaxis, the prevention of the disease. The epidemiology of yellow fever was a mystery to the older observers, and they were divided into two camps, the "contagionists" and the "non-contagionists," who considered it a "place disease," and in different outbreaks the facts seemed equally favourable to either; this, of course, was due to the transmission of the disease by the mosquito. The first to direct attention to this fact was Beauperthuy (1850–60), who taught in no uncertain manner that the agent which propagated yellow fever was the "house-haunting mosquito." Finlay, of Havanna, came to the same conclusion in 1881, and undertook direct experiments to substantiate his views, with a certain amount of success, but it was only after years of bitter controversy and Ross's discovery of the part played by mosquitoes in the transmission of malaria that the American Commission in 1899 definitely established the *rôle* of Stegomyia in the transmission of the disease. The prevention of yellow fever therefore resolves itself into (*a*) the destruction of Stegomyia by removal of breeding places, "screening" of water receptacles, fumigation of dwellings, oiling of ponds, &c.; (*b*) prevention of mosquito bites by wire-gauze screening of windows and doors so far as possible, and the use of the mosquito net; and (*c*) segregation and careful screening of the sick, so as to prevent access and infection of the mosquitoes. Fortunately, in one sense, the Stegomyia mosquito is largely a domestic species, and its breeding places are almost exclusively *artificial* collections of stagnant water, including all receptacles in which, by accident or design, water is caught, stored, and not repeatedly renewed, such as old pots and tins, flower-pots, tanks, tubs, broken crockery, bottles, &c. Boyce says he has never found it breeding more than 50 to 100 yards from the abode of man. This fact renders the extermination of this species of mosquito a far easier matter than in the case of the anophelines which convey malaria. The practical outcome of such anti-mosquito measures may be realised when it is stated that by their adoption yellow fever has been completely stamped out in Havanna, which up to 1909 always suffered severely from the disease. The book is admirably illustrated, and concludes with a summary on quarantine administration.

R. T. H.

THE JOURNALS OF THE FIRST SURVEYOR-GENERAL OF INDIA.[1]

IN 1906 Sir Rennell Rodd, G.C.V.O., now British Ambassador at Rome, presented to the Victoria Memorial Collection at Calcutta a small quarto volume containing the journal of his great-grandfather, Major James Rennell, F.R.S., which covered a portion of the period which he spent in India. The present editor, Mr. T. H. D. La Touche, was desired by the Director of the Geological Survey of India to see whether it contained anything of geological interest, but though such information is wanting except in so far as striking and important changes have taken place in the courses of rivers in Bengal since Rennell's

[1] "The Journals of Major James Rennell, First Surveyor-General of India." Edited by T. H. D. La Touche. Memoirs of the Asiatic Society of Bengal, vol. iii., pp. 95–248.

surveys, the journal is of the highest interest for its careful and precise account of the physical aspects of the country, its climate, crops, communications, &c.

The period covered by the journal is from May, 1764, to March, 1767. Rennell had just received a commission as probationer engineer in the fort then being erected at Calcutta, near Fort William, and was ordered on May 6 to make a survey of the Ganges eastward of Jelenghee, in order to find out the nearest passage from the Ganges to Calcutta in the dry season, and to report fully on the appearance and products of the country passed through to Mr. Vansittart, the Governor of Bengal. This journal was then kept in pursuance of the Governor's orders, and in it we find daily notes on the weather, the width and depth of the river at high and low water, with many notes on the navigability of the channels traversed, until August 4, when the expedition came to an end.

Six weeks later he started on a second expedition to survey the Ganges from the point reached in the former expedition as far as Dacca, where he was taken ill. As soon as he had recovered he carried his survey to the junction of the Meghna and the Ganges, which his observations show to have then been about a degree farther north than it now is. This expedition ended in May, 1765, and besides carrying out his own surveys, we see from the "Journal" that he was also occupied in collecting from others all such material as would be of service in compiling a general map of Bengal. After two months engaged in surveying on the Meghna and Brahmaputra Rivers the "Journal" passes to the fourth expedition undertaken at Lord Clive's orders in order to form a general map of Bengal, for which distances were to be taken in a cursory manner, only latitudes being used to correct them. In February he was seriously wounded in a fight with a body of Sanashi fakirs, and incapacitated from work until June, but so effectively had he pushed on his survey that on Lord Clive's sudden departure at the end of January, 1767, Rennell was able to supply him with a map of Bengal and a part of Bahar, and another of the Ganges from Patna to Kananj, on the scale of 10 miles to one inch. On January 1, 1767, he notes that he was appointed Surveyor-General, and mentions the four officers who were appointed as his assistants, among whom he apportioned the country to be surveyed.

A large collection of itineraries, latitudes, observations for magnetic variation, and various memoranda complete the volume, which gives a vivid picture of the conditions under which the first surveys in India were carried out. At this time few instruments of precision were available, and his surveys were made with a compass and the chain, while he employed a Hadley's quadrant for the determination of latitudes. Even with such simple equipment he worked with remarkable accuracy, and many places fixed by him are found by subsequent measurement to agree closely with their true positions, though his instruments left much to be desired, as errors of 6 and 8·5 inches in his chain length, which are recorded among the memoranda of his "Journal," show. It was no doubt his own skill in carrying out route surveys and controlling them by astronomical observations that prejudiced Rennell at first against Major Lambton's procedure of triangulation.

The "Journal" is a record of the highest interest, and geographers are much indebted to the editor for his labours, and to the Asiatic Society of Bengal for publishing it, together with a map of Bengal and Bahar from Rennell's "Bengal Atlas" to illustrate it.

H. G. L.

NOTES.

A STONE has recently been put up in Teddington Church in memory of Stephen Hales, who, in addition to being a distinguished man of science, was for fifty-one years the faithful vicar of that parish. He died in 1761, and was buried under the tower in what now serves as the entrance to the church. The fact that Hales was so buried was perfectly well known, and it is hard to say why a morning paper should assert that a number of learned men have hitherto sought for his tomb in vain. It was also known that the gravestone was being worn by the feet of Teddington congregations, and this it was that suggested the erection of a mural tablet on which the epitaph might be permanently preserved. The necessary funds were raised by subscriptions from a number of leading botanists. The students attending a course of lectures on the history of botany at University College, London, also materially helped with contributions. The Vicar of Teddington, the Rev. A. Cazalet, has taken a kindly interest in the scheme, and has been good enough to put up the tablet on the wall close to the burial place of Hales. The inscription is as follows:—"Beneath is the grave of Stephen Hales. The epitaph, now partly obliterated but recovered from a record of 1795, is here inscribed by the piety of certain botanists. A.D. 1911. 'Here is interr'd the body of Stephen Hales, D.D., Clerk of the Closet to the Princess of Wales, who was Minister of this Parish 51 years. He died the 4th of January, 1761, in the 84th year of his age.'"

MR. W. LEO BULLER has presented to the Dominion Museum, Wellington, New Zealand, an extremely valuable collection of about 700 Maori ethnological specimens which had been collected by his illustrious father, Sir Walter Buller, the well-known authority on the birds of New Zealand. The benefaction includes a large and representative collection of valuable historical greenstones, including both personal ornaments and weapons; a number of house carvings; a large pataka; a large carved war canoe with all its ornamental fittings, and a small, beautifully modelled light canoe; a collection of stone tools, adzes, &c., including the largest and finest stone adze at present known; a specially valuable collection of Maori garments, two being dog-skin cloaks in a perfect state of preservation, which were acquired in 1838; a number of other objects of Maori workmanship, many of which are of historic interest. In addition to these specimens, the collection will be completed by sending out to New Zealand the objects now in the Imperial Institute collected by Sir Walter Buller. It is difficult to overestimate the value of this donation, and when the gift was announced in the New Zealand Parliament by the Prime Minister it was received by members with expressions of very warm appreciation. We may now anticipate with confidence that the Dominion Government will at last build a museum to house its natural history and ethnological specimens, the value of which cannot be reckoned in money, but which are contained in an inflammable "old shed of a museum." It is satisfactory to know that the new specimens will be under the care of Mr. Hamilton, the director of the Dominion Museum, who has himself made valuable contributions to our knowledge of the arts and crafts of the Maoris.

NEWS has just reached us of the death, on January 12, of M. T. Durand, member of the Royal Academy of Belgium, director of the State Botanic Garden, and general secretary of the Royal Botanic Society of Belgium.

THE Academy of Natural Sciences of Philadelphia has awarded the Hayden medal in gold for distinguished work in geology to Prof. J. C. Branner, of Leland Stanford Jr. University, U.S.A.

THE Royal Geographical Society has arranged for a course of three lectures on "The Desert of North Africa," to be given by Captain H. G. Lyons, F.R.S., in the Theatre, Burlington Gardens, on February 9, 13, and 15.

AN official intimation from the Musée National d'Histoire Naturelle de Buenos Aires informs us that Dr. Angel Gallardo has been appointed director of that institution in succession to Dr. Florentino Ameghino, who died on August 6, 1911, at fifty-six years of age.

AT the ordinary scientific meeting of the Chemical Society held on Thursday, January 18, the president, Prof. Percy F. Frankland, F.R.S., announced that the Moissan memorial lecture will be delivered in the rooms of the society by Sir William Ramsay, K.C.B., F.R.S., on Thursday, February 29, at 8.30 p.m.

So much interest has been aroused by the exhibition of bird tables and nesting-boxes in the offices of the Selborne Society at 42 Bloomsbury Square, W.C., that it has been decided to allow the collection to remain on view until January 31. The hours are from 11 a.m. to 5 p.m. on weekdays, except Saturday, when the exhibition closes at 3 p.m.

IT will be remembered that M. Maurice Maeterlinck last year received the Nobel prize for literature. The prize amounted to 7772*l.* We learn from the *Revue Scientifique* that M. Maeterlinck proposes to raise the sum to 8000*l.*, and to employ it to establish a biennial prize of 640*l.* to be awarded to the author of the most remarkable work—whether on literature, art, or science—published in the French language.

IN December last one of the massive sarsen stones still remaining of what is known as Longstone Cove, or Longstones, standing in the ploughed field to the right of the road from Avebury to Beckhampton, which, according to Stukely, formed an adjunct to the Beckhampton Avenue leading to Avebury, fell down. Its weight is estimated to be more than 30 tons. The Wiltshire Archæological Society, through its secretary, the Rev. E. H. Goddard, Clyffe Vicarage, Swindon, now appeals for assistance in raising the sum of about 50*l.* required to re-erect the stone and support it by a concrete foundation, the funds of the society being inadequate to undertake such a work.

WE regret to see the announcement of the death, on January 21, in his eighty-second year, of Dr. David Christison, one of the foremost antiquaries in Scotland. From an obituary notice in *The Times* we learn that he was secretary of the Society of Antiquaries of Scotland for sixteen years, from 1888 to 1904. He travelled over a great part of Scotland planning the prehistoric forts and minutely examining them, and the results of his investigations he contributed in many interesting papers to the Society of Antiquaries. About twenty years ago he was Rhind lecturer, and chose as the subject of his course "The Prehistoric Forts of Scotland." These lectures were published in book form. "Early Fortifications in Scotland" was another of his works. In 1867, for the benefit of his health, Dr. Cristison visited Argentina, on which he wrote a number of papers. A keen student of botany, he was a member of the Botanical Society, to which he made several communications, particularly on the growth of trees.

ON Thursday, February 1, Prof. A. M. Worthington will begin a course of two experimentally illustrated lectures at the Royal Institution on "The Phenomena of Splashes," and on Saturday, February 3, Sir Alexander C. Mackenzie will deliver the first of a course of lectures, with musical illustrations, on (1) "Russian Music of To-day," and (2 and 3) "Franz Liszt (Centenary)." The Friday evening discourse on February 2 will be delivered by Sir James Mackenzie Davidson on "Vital Effects of Radium and other Rays," and on February 9 by Dr. J. A. Harker on "Very High Temperatures."

THE Liverpool excavations at Meroë, under the direction of Prof. Garstang, assisted by Mr. Schliephack, are making great progress. The palace of the Ethiopian kings, near the temple of Amon, proves to contain more than forty chambers and a large court. On the foundation-walls are reliefs of the usual Ethiopian pattern. Three hundred Sudani natives are now employed, with a staff of trained Egyptian diggers, chiefly fellâḥîn from Ḳuft. A light man-tramway, of the kind commonly utilised in excavations elsewhere (*e.g.* at Abusir and Deir el-Bahari) to facilitate the removal of the excavated material, has been installed, and to this Mr. Garstang has added a small aërial cableway. A telegram from Khartûm describing the progress of the work appeared in *The Times* of January 17; from this the above account is partly taken.

AT the annual general meeting of the Royal Meteorological Society on January 17 the president, Dr. H. N. Dickson, presented to Prof. Cleveland Abbe, of the U.S. Weather Bureau, Washington, the Symons gold medal for 1912, which had been awarded to him in consideration of his distinguished work in connection with instrumental, statistical, and dynamical meteorology and forecasting. The following officers and members of council for the ensuing year were elected at the meeting:—*President*, Dr. H. N. Dickson; *vice-presidents*, R. H. Hooker, R. G. K. Lempfert, H. Mellish, Colonel H. E. Rawson, C.B.; *treasurer*, Dr. C. T. Williams; *secretaries*, F. C. Bayard, Commander W. F. Caborne, C.B.; *foreign secretary*, Dr. R. H. Scott, F.R.S.; *councillors*, W. W. Bryant, C. J. P. Cave, Dr. C. Chree, F.R.S., F. Druce, F. W. Dyson, F.R.S., E. Gold, Commander M. W. C. Hepworth, C.B., R. Inwards, Captain H. G. Lyons, F.R.S., M. de C. S. Salter, Captain A. Simpson, and Sir J. W. Towse.

A MEMORANDUM of revised arrangements between the Board of Agriculture and Fisheries and the Board of Education in regard to agricultural education in England and Wales has been issued. It is pointed out that in view of the large additional sums which have become available since 1909 for the purposes of agricultural education and research under the Development and Road Improvement Funds Act, 1909, the arrangements made in 1909 now require some modification. It no longer appears possible to delimit the spheres of work of the two Boards by assigning to the Board of Agriculture the responsibility for the universities and colleges in which advanced work is being done, and to the Board of Education the responsibility for farm schools and such other provision for agricultural education as is on a lower plane than that of agricultural colleges. It has therefore been decided that, in future, the responsibility for farm institutes, as well as for the agricultural work of universities and colleges, shall be transferred to the Board of Agriculture, and that this Board shall be regarded as the Government department concerned with this branch of educational work for the purposes of the Development Fund. The application for an advance from the Development Fund in aid of farm

institutes, which has been made by the Board of Education, will therefore be withdrawn by them. A fresh application for an advance in aid of farm institutes will in due course be put forward by the Board of Agriculture.

A MEETING of the London Section of the Association of Chemical Technologists will be held at St. Bride's Institute, Bride Lane, Fleet Street, E.C., on Friday, January 26, when a paper will be read by Mr. J. W. Hinchley on the technologist and the factory. The association was inaugurated about a year ago, and its constitution was decided at a general meeting held on December 11 last. Among the objects of the association are the following:—(1) to extend the study and practice of applied chemistry so as to enable this country to compete industrially on equal terms with the most commercially progressive countries abroad; (2) to promote a wider appreciation of the value to the country of applied chemistry, and to obtain for it the active support and encouragement which, from its great economic importance, it deserves; (3) to promote the growth of a distinct profession of applied chemistry, and thus to place this profession upon such a basis that the applied chemist may be at no disadvantage in comparison with his fellows in allied professions; (4) to effect the cooperation of applied chemists for all matters which may promote their interests; (5) to raise a fund to furnish grants for assisting persons approved by the council to obtain training in applied chemistry at approved institutions or chemical works, either in this country or abroad, and to furnish grants for the prosecution of technical research; (6) to assist members of the association to obtain advice in patent matters. Any further information may be obtained from the secretary, 30 Victoria Street, Westminster, London, S.W.

THE Decimal Association has recently made special efforts to bring the advantages of the metric system more fully before the public. The association is now prepared to find a lecturer and to pay his expenses wherever a good audience can be assured, and it suggests that chambers of commerce, education committees, and trade protection societies will do well to take advantage of this offer. A meeting is to be held on January 26, when Mr. Alexander Siemens will address the London Teachers' Association. A pamphlet circulated by the association shows that in Malta the compulsory adoption of the metric system began on January 1 last. The Central American Republics of Nicaragua, Honduras, Costa Rica, San Salvador, and Guatemala have passed the necessary measures to enforce the metric system as from January 1, 1912. China has decided to adopt the metric system. An Act rendering the metric system compulsory in Bosnia-Herzegovina has been passed by the Government of that country, and will come into force on September 1, 1912. The Danish Weights and Measures Act was passed in 1907, and will come into force in April, 1912. The pamphlet points out that the metre and the kilogram are gaining ground in every direction, and that the number of non-metric countries is being reduced steadily; it continues, "the metric system is gradually closing in upon these islands, and it only requires the adoption of the system by one of our great colonies to cause very much more serious attention being given to the subject by the Government of this country."

THE Smithsonian Biological Survey of the Panama Canal zone, begun in December, 1910, and continued through the major part of 1911, is being pushed to completion before the opening of the canal in 1913. The second expedition sailed on January 9 to take up the work for another season, the botanist, Prof. Pittier, being the only naturalist who remained in the field since the beginning of the survey. Although much interesting information has been collected, and a great many specimens secured, nothing like a complete report is ready. The party includes Dr. Seth E. Meek, formerly of the Bureau of Fisheries, but now representing the Field Museum of Natural History; Mr. S. F. Hildebrand, of the Bureau of Fisheries, who will collect fishes, reptiles, and amphibians; Mr. E. A. Goldman, of the Biological Survey, Department of Agriculture, who will collect birds and mammals; and Prof. Charles D. Marsh, of the Bureau of Plant Industry, Department of Agriculture, who will collect and study the microscopic plant and animal life of the fresh waters of the zone. As can readily be imagined, the life-areas on the zone will become confused as soon as the canal is opened and the waters of the Pacific and Atlantic watersheds are intermingled. It is particularly important on that account that the present geographical distribution of animals and plants be recorded prior to that time, and this is especially true as regards the life of the fresh waters and the sea-coasts. The work of the survey is being carried on through the united efforts of the Smithsonian Institution, several of the U.S. Government departments, and the Field Museum of Natural History of Chicago, and the hearty cooperation of the Panama Canal Commission has been an important factor in the success of the undertaking.

THE U.S. Bureau of American Ethnology is preparing a new work which will form a handbook of aboriginal remains in the United States, and will have to do with the ancient abodes, camps, mounds, workshops, quarries, burial places, and so on of the Indian tribes. Letters of inquiry are being sent to all persons, institutions, and societies thought to have any knowledge of American archæology and ethnology. In 1891 a catalogue of prehistoric works east of the Rocky Mountains was published, but that work is both out of date and out of print. The parts of the United States most densely populated by the aborigines must have been the basins of the Mississippi and Ohio Rivers and the southern shores of the Great Lakes, although there are indications of many settlements on the Atlantic coast, especially in Florida. The history of the American Indians forms an attractive subject of inquiry, but the data available are rapidly decreasing. The fact that the customs, folk-lore, and traditions of these people are being lost through advancing civilisation, and that the older Indian authorities and characters are rapidly passing away, makes it more and more difficult to preserve the history of the Indians for future generations. Through the thorough methods of the Bureau of American Ethnology, devoted to the recording of the habits, customs, and history of the American Indians, many valuable data are, however, constantly being compiled.

ANTI-TYPHOID vaccination by means of a vaccine prepared with killed cultures of the typhoid bacillus, as a preventive of typhoid fever, has of late been extensively practised. Last year a French commission reviewed the results obtained, and recommended its adoption in certain circumstances. In the "Report on the Health of the Army for 1910," recently issued, it is stated that on December 31, 1910, out of 71,623 European troops in India, no fewer than 58,481, or 81·7 per cent., had been vaccinated, some once, some twice, some more than twice. Of 335 cases of typhoid occurring in the Indian Army in 1910, 187 were inoculated men and 148 were not inoculated

men. Twenty-two deaths occurred among those inoculated and twenty-four deaths among those not inoculated. The ratio per 1000 of strength of admissions for enteric fever among the inoculated was 3·19, and the corresponding ratio of deaths was 0·37. Among the not inoculated the admission ratio per 1000 of strength was 12·72, and that for deaths was 2·06. As regards case mortality, the percentage figures are 11·23 for the inoculated and 16·89 for the not inoculated. There thus seems to be a very strong case in favour of anti-typhoid vaccination.

IN *The Field* of December 30, 1911, Mr. Lydekker suggests that the so-called unicorn rams of Nepal, of which living examples were exhibited a few years ago in the Zoological Gardens, are an artificial product. Mr. Lydekker's views are, however, disputed by Mr. Pocock in the same journal of January 13. In *The Scottish Naturalist* for January Mr. H. J. Elwes gives the first instalment of notes on the primitive sheep of the Scottish islands, dealing in this instance mainly with those of the Shetlands. The paper includes illustrations of a ram and a ewe of the short-tailed Soay, or Soa, breed, which is perhaps the most primitive of all.

PALÆOBOTANISTS are well served by the publication "Die Palaeobotanische Literatur," of which the second volume, compiled, as was the first, by Dr. W. J. Jongmans, has been published by Gustav Fischer, Jena (price 18 marks). This volume catalogues contributions issued in 1909, and contains also a few papers of the previous year. The first section provides a bibliography; the second section, forming the main portion of the work, presents an alphabetical list of references for families, genera, and species.

Two important contributions to the flora of Siam were published last year. A systematic catalogue, appearing in the *Beihefte zum Botanischen Centralblatt* (vol. xxviii., part ii.), deals with the plants collected by Dr. C. C. Hosseus in 1906. It amplifies the list communicated by the author to the preceding volume by the incorporation of new identifications; among the latter, the family Orchidaceæ attracts attention on account of numerous new species and the large number of species of Dendrobium. A more comprehensive list is that provided by Mr. W. G. Craib, who has worked out the collections of Dr. Kerr and officers of the Siam Forest Service, and has embodied his determinations of the dicotyledonous plants in the first and last numbers of *The Kew Bulletin* (1911). This enumeration indicates a preponderance of species in the families Leguminosæ, Euphorbiaceæ, Rubiaceæ, and Acanthaceæ; the Cupuliferæ consists of twelve species of Quercus and four of Castanopsis; new species are abundant.

THE experimental trials of different varieties of sugar cane that have been maintained in the Leeward Islands for eleven successive seasons furnish each year new facts or premises. The latest report, for 1909–10, bears testimony to the value in Antigua of the established variety, Sealy Seedling, and a seedling introduced recently from Barbados; similarly, an older and a new variety, different from the two former, have yielded the best returns in St. Kitts. It has been recognised that the results of the experimental trials must not be too hastily followed up on the sugar estates; there has certainly been no precipitate change in Antigua, where White Transparent still occupies two-thirds of the total acreage; in St. Kitts, however, a seedling introduced in the earlier trials has displaced that standard variety from the premier position. An increase in the amount of root disease caused by the fungus *Marasmius sacchari* is noted, for which rotation with cotton is suggested as a remedy. The manurial experiments recorded in a separate part are now confined to ratoon canes; the new fertilisers, nitrolim and nitrate of lime, were introduced for the first time.

A COPY of the report for the year 1911 of the Philosophical Institute of Canterbury, N.Z., has been received. During the year the membership reached its highest for many years, and the financial position of the institute is very satisfactory. The report points out that the council of the institute has considered it a duty constantly to urge the importance of preserving the native fauna and flora of New Zealand, and when it was suggested recently that Kapiti Island, one of the Dominion's sanctuaries, could with advantage be used as a holiday resort for Wellington, representations were made to the Government as to the retrograde nature of the proposed step, and the council has had the satisfaction of eliciting from the acting Minister of Lands a statement that it is not intended to interfere with the position of the island as a sanctuary. The council has also urged on the Government the desirability of using the s.y. *Terra Nova* in investigating the biological and hydrographical problems of the New Zealand continental shelf. Its representations have not been accepted, but it is to be hoped that the work which has been done by the *Terra Nova* in the waters immediately to the north of New Zealand may result in substantial additions to scientific knowledge of the marine fauna of that area, as well as conduce to the safety of shipping between Australia and this country. The president of the institute for the present year is Dr. L. Cockayne, and the honorary secretary Dr. C. Coleridge Farr.

THE summary of the weather for the week ending January 20, issued by the Meteorological Office, shows that the conditions were generally unsettled throughout the period. Heavy falls of rain, sleet, or snow occurred in every part of Great Britain. The aggregate rainfall was in excess of the average over the entire kingdom, except in the north of Scotland and the north of Ireland, the excess being large in most parts of England and in the west of Scotland. In the northern and Midland counties the precipitation was chiefly snow. At Southport the depth of snow on the morning of January 17 was 7 inches, whilst a similar quantity was reported next morning at Cirencester, and a depth of 8 inches at Bath. In the south and south-east of England the fall of snow was very slight. There was a decided rise of temperature towards the close of the week, and the snow rapidly disappeared. The melted snow, combined with the copious rains, occasioned floods in many parts of the country. At the end of the week the large European anticyclonic system, which had extended from Siberia to Norway, and at the centre of which the barometer was above 31 inches, had decreased considerably in intensity. For the time the threatened cold spell had disappeared, and damp and mild weather had again set in.

IN a memorandum dated Simla, December 11, 1911, referring to the probable character of the rains from December, 1911, to February, 1912, in northern India, the officiating director-general of observatories explains that the falls during the winter season occur during the passage of disturbances which have been shown to reside in the upper and middle strata of the atmosphere. When these depressions show themselves, their line of travel varies considerably from year to year, and it is chiefly

owing to this fact that the rains at that season are so variable and erratic. The present knowledge of the upper air currents is scanty, and it follows that forecasts of the winter rains are considerably more tentative than those for the monsoons. On the basis of the history of past years which have shown a general similarity with 1911 in respect of meteorological statistics during October and November, it is estimated that the geographical average of the rains in question is not likely to be in defect in northern India; an excess is probable in the Punjab and the west of the United Provinces, but there may be a defect in Gujarat and Sind. The amount of snowfall in the west Himalayas may be expected to be above the normal.

POURING oil on troubled waters as a proverb is well known. The actual use of oil at sea for preventing waves from breaking is known, but not so universally. Messrs. Loveridge, Ltd., of The Docks, Cardiff, are supplying a convenient device for utilising oil economically. This is Couves's automatic "wave subduer." A cylindrical vessel containing a heavy piston is fixed in the ship near the bow, and a little above the water-line. Two narrow pipes pass from the bottom of this through the plating, one on either side of the stem, and these pipes are normally closed by taps. The vessel is filled with oil, and the piston is raised by a central screw. It is then ready at any moment to drive the oil through one pipe or both when the proper taps are opened. The amount of oil used per hour appears from a letter by a user to have been in his case about half a gallon only. Being only applied at the bow, the oil does not have time to do much to the waves that break over the bows, but, even so, it appears to have a marked effect further aft, that is, when meeting a heavy sea. With a following wind, however, the trail of oil would seem to be much more efficacious, and the great risk of being pooped at such times is no doubt greatly diminished.

THE application of "flashlight" photography to living microscopical organisms is discussed by Mr. Walter Bagshaw in the Journal of the Royal Microscopical Society for December, 1911, who points out the advantage, especially in photographing pond life, of using living instead of mounted specimens. Mr. Bagshaw has experimented on *Lophobus crystallinus*, caddis flies, water shrimps, &c., though he has not yet succeeded in photographing darting or rapidly moving objects. The "flashlight" powders give a total exposure of one-thirtieth of a second, irrespective of the quantity used. The best instant for exposure was determined by illuminating the object with a faint side-light and observing it through a hand magnifying glass. Should the method be brought into general use, there appears no reason why an apparatus should not be constructed which would enable the object to be viewed through the microscope and focussed up to the instant of exposure, as in the reflex camera. The same number of the Journal contains two interesting papers dealing with the optical resolution of minute structures, one by Mr. T. W. Butcher on the structural details of *Coscinodiscus asteromphalus*, the other by Mr. James Strachan on the scales of *Thermobia domestica*, an ally of the well-known *Lepisma saccharina*.

THE first number has been received of the Journal of the Association of Teachers of Mathematics for the South-eastern Part of England, which is to be published three times a year. It contains the presidential address delivered at the inaugural meeting at Tonbridge on November 24, 1911, by Dr. A. N. Whitehead, F.R.S., on "The Place of Mathematics in a Liberal Education." The new association consists of nearly fifty members, more than half of whom are women engaged in school teaching in the district in question, the secretary being Mr. G. St. L. Carson. It is intended to promote common action and unity of purpose among school teachers of all grades, including those only engaged in teaching arithmetic. The question may be asked, why is it not affiliated to the Mathematical Association? Mr. Carson, however, points out that England is almost alone in preserving an unnatural separation between the professed mathematician and the teacher of elementary mathematics, and he hopes the association may help towards bridging this chasm. In Dr. Whitehead's address we note several interesting suggestions, in particular he emphasises the view that modern education should be based more on a study of modern civilisation and less on that of the civilisation of the Greeks and Romans. In order to effect this object Dr. Whitehead would include in elementary mathematics exercises based on the statistics of modern commerce and politics. If this proposal should do anything to convince a future generation that modern politics ought to be treated as a science and made the subject of qualifying tests similar to those required for admission to learned professions, a useful purpose would be served.

ACCORDING to a reprint from the November (1911) number of the Proceedings of the American Academy of Arts and Sciences, Mr. E. L. Chaffee, of the Jefferson Physical Laboratory of Harvard, has devised a system which produces undamped electrical oscillations of extremely high frequency with greater regularity than any of the systems at present in use in wireless telegraphy or telephony. In principle, the method stands intermediate between the methods of Poulsen and of Wien. A direct-current generator of 530 volts is connected through variable resistances and inductances, and through the primary coil of a closely coupled oscillation transformer, to the oscillation gap. This consists of two parallel plates of one or two square centimetres area 0·07 millimetre apart, the anode being of copper or silver and the kathode of aluminium. Both anode and kathode are water or air-cooled, and are surrounded by moist hydrogen at atmospheric pressure. The primary of the transformer and the spark-gap are shunted by an air condenser, and another is placed in series with the secondary of the transformer. Both admit of variation to secure syntony. A thorough examination of the secondary oscillations has been made by means of the Braun tube oscillograph.

So much of the recent work on the properties of electrons depends on Stokes's law of resistance to the motion of a sphere in a viscous fluid, that careful tests of the validity of the law have become essential. According to a reprint from vol. xxxvi. of the *Annalen der Physik*, Prof. Knudsen and Dr. Weber, of the University of Copenhagen, find the law requires modification for small spheres moving through a gas, especially if the pressure of the gas is low. Their method depends on the observation of the logarithmic decrement of the torsional oscillations of a light rod 16 centimetres long with or without light glass spheres of a few millimetres diameter at its ends. The oscillating system was placed in an enclosure which could be evacuated, and observations were taken in air at pressures from 0·14 to 1 million dynes per square centimetre. The resistance to a sphere of radius r moving with velocity v through a gas of viscosity η is equal to

$$6\pi\eta r v/(1+0{\cdot}68l+0{\cdot}35le^{-1{\cdot}84/l}),$$

where l is the mean free path of the molecules of the gas divided by the radius of the sphere. It will be seen that the result involves an exponential term not given by the theoretical investigation of Cunningham or the experimental work of McKeehan, although the authors show that there is some indication of its effect even in the observations made by the latter.

A LECTURE, under the auspices of the Graham Lecture Fund was delivered on Tuesday, January 16, in the hall of the Technical College, Glasgow, by Prof. H. E. Armstrong, F.R.S. The lecture was arranged by the Royal Philosophical Society, and the subject selected was "Some Consequences of Graham's Work." The lecturer was dealing with a subject on which he was specially qualified to speak when he described the way in which Graham's work on diffusion had been developed in recent years. The effects produced by non-electrolytes, which are able to penetrate the membranes of living cells, and so to set going important physiological processes, are now recognised as factors of vital importance in the life and development of plants and animals; it was therefore a happy inspiration on the part of the trustees of the Graham Fund to secure from Prof. Armstrong himself a description of the experiments which have done so much to bring home to the physiologist, as well as to the chemist, the important results which have followed upon the pioneer work of Graham.

AN interesting study of the localisation and function of potassium in plants, by Dr. Th. Weevers, is contained in the *Recueil des Travaux botaniques Néerlandais* (vol. viii., p. 289), use being made of Macallum's very delicate microchemical test, based on the precipitation of potassium cobalt nitrite and subsequent conversion of this into black cobalt sulphide by treatment with ammonium sulphide. In a very large number of plant tissues tested, potassium was found always to be present, save in the Cyanophyceæ. In all cases the cell nucleus, however, contained no trace of this element, even in cases when the cytoplasm contained this element in abundance. Special experiments showed that this result was due neither to potash salts diffusing out of the nucleus under the treatment, nor to inability of the reagent to penetrate therein. The larger portion of the potassium is contained in the vacuoles of the cells, the chromatophores being free from it; chlorophyll also contains no potassium. In all cases tested the potassium was present in a form soluble in water, and can be extracted practically completely from the cell by water or 50 per cent. alcohol, but it seems to be insoluble in ether. In phanerogamous plants the potassium is most abundant in the parenchyma, especially in the growing points and reserve organs. In the secondary tissues potassium predominates in the living elements of the wood and bark, especially in the cambium and medullary rays; the latter seem to act as potash reserves for the growth of new shoots. In discussing the physiological significance of potassium in the plant, it is considered that this element plays little or no part in carbon assimilation, but probably is concerned more in building up protoplasm at growing points. In the leaf it probably functions in synthesis and degradation of the protein.

MESSRS. WITHERBY AND CO. are about to publish "The Game-birds of South Africa." The book is by Major Boyd Horsbrugh, and will be illustrated by nearly seventy coloured plates reproduced in facsimile from the drawings of Sergeant C. G. Davies. The work will be in small quarto, and will be issued in four quarterly parts.

OUR ASTRONOMICAL COLUMN.

SCHAUMASSE'S COMET, 1911*h*.—In the *Comptes rendus* for January 8 (No. 2) M. G. Fayet announces his tentative conclusion that the comet discovered by M. Schaumasse at Nice on November 30, 1911, is a periodic comet with a period of about seven years. A parabolic orbit first calculated showed such digressions from the observed places that an elliptic orbit was tried which gave satisfactory O–C differences for intermediate positions. The preliminary elements, determined from positions observed at Nice on December 1, 11, 16, and 21, 1911, are as follows:—

$$T = 1911 \text{ November } 12{\cdot}2440 \text{ M.T. Paris.}$$

$$\left.\begin{aligned} \pi &= 136^\circ\ 33'\ 37'' \\ \Omega &= 93^\circ\ 14'\ 32'' \\ i &= 17^\circ\ 40'\ 46'' \end{aligned}\right\} 1911{\cdot}0$$

$$\log q = 0{\cdot}084487$$
$$e = 0{\cdot}675480$$
$$\mu = 489{\cdot}938''$$

The data are, of course, too meagre for any certainty to be claimed for these elements, but it is worthy of notice that on December 28 the departure of the observed place from M. Fayet's ellipse was only 15″.

THE DISTRIBUTION OF BRIGHTNESS IN THE TAIL OF HALLEY'S COMET.—Some important results concerning the nature of the particles in the tail of Halley's comet, and of their illumination, are obtained by Drs. Schwarzschild and Kron in a paper of which a translation is printed in No. 5, vol. xxxiv., of *The Astrophysical Journal*. The material for the discussion was provided by plates secured by the Potsdam Observatory expedition to Teneriffe to observe the comet.

The photographs were secured in pairs, and photometric standards for comparing the density of the image were produced simultaneously; the photographs show that the apparent intensity of the tail diminishes continuously from the head outward. This diminution might be produced by two causes, first the decrease in density of the tail matter, secondly by a decrease in the actual luminosity of the individual particles; decrease in density would be produced by increase in cross-section of the tail as units further from the head were considered, and by the greater velocity of the particles through each section produced by the solar acceleration.

The density effect was very carefully calculated by the authors, and, to their surprise, was found to account, in the most part, for the decrease of brightness. It should be remembered, however, that several unknown quantities enter into the conditions discussed. This result, if legitimate, can be explained by assuming that the light of a comet's tail is a kind of fluorescent or resonant radiation excited by the solar radiation. On this basis they calculate the amount of matter passing through a unit section, and also the density, and find that, exposed for a whole day to the conditions obtaining at the time of its passage through the tail, the earth would not collect more than 250,000 kilograms of cometary matter, a relatively insignificant amount.

OBSERVATIONS OF PLANETS.—In No. 4548 of the *Astronomische Nachrichten* is published a telegram, received from Prof. Lowell on January 12, announcing that since the last presentation the canal Titan on Mars has doubled.

M. Jarry-Desloges reports that the south polar cap reappeared, as two distinct masses, on January 3, and that the abnormal white streak at the north pole going south between Propontis and Palus Mæotis, had completely disappeared on that date.

The latter also states that on December 29, 1911, at 23h. 30m., the south polar regions of Saturn were covered by a well-defined dark area having an equally well-defined greyish area at its centre; taking the equatorial diameter of the planet as unity, the respective diameters of these patches were 0·31 and 0·11. At 23h. 15m. the same evening the eastern anterior portion of the rings appeared very notably darkened, but the phenomenon did not endure more than twenty-four hours. The farther eastern section of the exterior ring, as compared with the Cassini division, was also darkened. At this time the inner transparent

ring was rather difficult, but on December 30 it was easily seen and its granular structure detected.

THE "ANNUAIRE" OF THE BUREAU DES LONGITUDES, 1912.—This year's issue of the "Annuaire" contains the usual astronomical information, ephemerides, and tables, and deals with chemistry and physics similarly. It also contains the complete list of minor planets, for 714 of which it gives the orbital elements. Among the "notes" there appear an interesting *résumé* of solar physics by M. Deslandres, a long discussion on the various calendars, an article by M. Bigourdan on seismology, a brief description of the physical constitution of the moon by M. Puiseux, and a discussion of the mean temperature in various parts of France by M. Bigourdan. All the times in this "Annuaire" are given in accordance with the new law of March last. The price of the "Annuaire" is 1.50 francs net.

THE RADIAL VELOCITIES AND SPECTRAL TYPES OF STARS.

ALTHOUGH the determination of radial velocities is, as a practical proposition, a development of comparatively recent years, the data already secured by the several observatories doing line-of-sight work promises to be of inestimable value in the study of cosmological problems. It is no longer merely a question of "approach" or "recede"—a far greater vista has been opened up as the work has proceeded. Combined with the researches of Kapteyn, Eddington, Dyson, and others on the streaming tendencies disclosed by the discussion of "proper motions," it promises a rich mine of as yet undisclosed facts concerning the evolution of enormous sidereal systems.

A glance through Prof. Campbell's second catalogue of spectroscopic binaries[1] tells of much work already accomplished, and the discussion discloses how much there is still to be done.

One outstanding result of this discussion of more than 300 binary systems, so far as it applied to the comparative few for which the periods of revolution and other orbital elements have been determined, was the fact that the motions of the stars are intimately related to the spectral types which may be taken as indices of stellar ages. Briefly, it appears that the older a binary system becomes the greater becomes the eccentricity of the orbit and the longer grows the period of revolution.

The existence of the relation between radial velocities and stellar types was also brought out in a later paper[2] dealing with some peculiarities in the motions of the stars, where the following table was given, the spectral types being given under the Harvard designations:—

Spectral types	No. of stars	Average radial velocities
O and B	141	8·99 km.
A	133	9·94 ,,
F	159	13·90 ,,
G and K	529	15·15 ,,
M	72	16·55 ,,

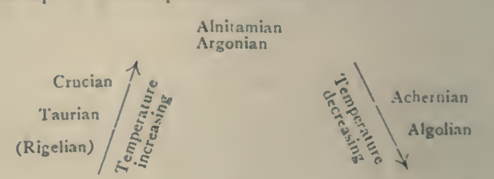
In the general discussion it was found that the B-type ("helium") stars called for special treatment, and Prof. Campbell discussed the motions of the brighter stars of this type in a further paper.[3]

The main conclusion to which we wish to direct attention here is that "An error, of obscure source, causes the radial velocities of Class B stars to be observed too great by a quantity, K, amounting to several kilometres. For stars of Class B–B_5 the value of this error is approximately K = +4·7 km. per second. The value obtained for Class B–B_9 stars is +4·1 km. It is therefore probable that K is less than +4 km. for stars of Class B_8–B_9."

The result was based on the consideration of 225 Class B stars, K being an assumed, unavoidable, but systematic error inherent to the observed velocities, and disclosed in calculating from these the velocity of the solar system in space. This systematic difference, peculiar to the B-type stars, has led to some very interesting and important suggestions as to the characteristics of the stars themselves; Prof. Campbell makes several tentative suggestions as to its source. Of these, we would direct attention to that in which it is suggested that in these stars the absorption takes place in the lower layers of the atmospheres, and therefore under greater pressure, thus modifying the effective wave-length and producing the error when the measures of wave-length are compared with terrestrial standards. Another suggestion points out that the helium lines frequently used in the measures are double, with the red component, in the laboratory, much the fainter. If the conditions in the star increase the relative intensity of these red components, the wave-length of the centre of gravity of the whole line would be shifted, and the observed difference be thus produced.

A most interesting contribution to the discussion of the motions of this type of star is published by Dr. Ludendorff[4] in the form of some remarks on the classification of helium stars. He takes from Campbell's list of 224 stars all those which have an absolute radial velocity, V_2, $\geq$ 8·0 km., and shows that there is a distinct differentiation of their velocities if they are arranged according to Lockyer's classification[5] of the helium stars.

As is generally known, this classification is unique in that it aims at arranging the classes of stars in an evolutional order, difference in the chemical characteristics, accompanying differences in age and temperature, being the criterion. It also essentially takes into account the idea that stars probably increase before decreasing in temperature, and on these lines arranges the helium stars at the top of the temperature curve thus:—



In the Lockyer classification the Rigelian class is not given as essentially a helium class, although helium is mentioned as one of the prominent elements; for this latter reason Dr. Ludendorff includes it in his discussion.

Of the sixty-three stars selected from Campbell's list, he finds eighteen classified in the South Kensington catalogue, and tabulates them as follows, the velocities being given in round numbers:—

Ascending branch of Curve			Descending branch of Curve		
Star	Type	V_2	Star	Type	V_2
		km.			km.
ζ Persei	Crucian	+ 9	π Andromedæ	Algolian	+ 8
η Orionis	,,	+14	ν ,,	Achernian	−24
β Canis Maj.	,,	+10	19 Tauri	Algolian	−10
o^2 ,,	Taurian	+25	γ Corvi	,,	−13
η ,,	,,	+17	ι Aquilæ	Achernian	−14
δ Crucis	Crucian	+13	ε Delphini	,,	−10
χ Centauri	,,	+ 8	α ,,	Algolian	−10
ε Lupi	,,	+12	o Andromedæ	Achernian	−10
υ Scorpii	,,	+21			
67 Ophiuchi	Rigelian	+10			

From this table evolves the striking fact that, without exception, those stars placed by Lockyer on the ascending arm of the temperature curve all have + velocities, and, with one exception, those on the descending side have − absolute radial velocities. It would appear extremely unlikely that this remarkable division is due to chance; but Dr. Ludendorff seeks further evidence by taking from Campbell's catalogue all (seventy-one) those stars classified at South Kensington as helium stars—including the Rigelian class—and arranges them as follows, giving the mean absolute radial velocities V_2* of each class:—

[1] Lick Observatory Bulletins, No. 181. [2] *Ibid.*, No. 196. [3] *Ibid.*, No. 195.

[4] *Astronomische Nachrichten*, No. 4547, vol. cxc., p. 193.

[5] Catalogue of 470 of the Brighter Stars Classified according to their Chemistry.

α. Ascending arm of Lockyer's curve.

1. Rigelian stars	$V_2^0 = +2\cdot3$ km.	3 stars
2. Taurian ,,	$= +8\cdot8$,,	4 ,,
3. Crucian ,,	$= +3\cdot7$,,	38 ,,

β. Maximum of Lockyer's curve.

1. Alnitamian stars	$V_2^0 = -0\cdot4$ km.	5 stars
2. Argonian ,,	—	0 ,,

γ. Descending arm of Lockyer's curve.

1. Achernian stars	$V_2^0 = -5\cdot4$ km.	11 stars
2. Algolian ,,	$= -3\cdot7$,,	10 ,,

Grouping them further, and taking general means for each of the groups α, β, and γ, we get:—

α. $V_2^0 = +4\cdot1$ km.	45 stars	mean error	$\pm 1\cdot03$ km.
β. $V_2^0 = -0\cdot4$,,	5 ,,	,,	$\pm 1\cdot29$,,
γ. $V_2^0 = -4\cdot6$,,	21 ,,	,,	$\pm 1\cdot72$,,

It is obvious that the β group is so small, and its mean error so much greater than the mean value of the velocities, that it is negligible, and Dr. Ludendorff considers only the α and γ groups; the difference between these is $+8\cdot7$ km., with a mean error of $\pm 2\cdot0$ km.

Further analysis shows that, of the forty-five stars in group α, thirty-one have V_2 positive, with a maximum of +25 km., and fourteen negative, with a maximum negative value −7 km., while the mean of the + values is $+7\cdot2$, and that of the negative values $-2\cdot8$.

Analysing similarly the γ group, the mean $-V_2$ is 8·8 km., and the mean $+V_2$ is $+3\cdot9$ km., so there can remain no reasonable doubt as to the reality of the connection between + values and "ascending" stars and − values and "descending" stars.

Taking these same seventy-one stars and arranging them under the Harvard equivalents of the Lockyer classes is rather a hazardous proceeding on account of the generical differences of the two classifications with their consequent overlappings; but Dr. Ludendorff has done it systematically, and finds that the mean velocity difference between the analogues of the α and γ groups employed above is $+3\cdot6$ km., with a probable error of $\pm 2\cdot41$ km. It is evident that the systematic difference so obvious in the previous tables is somewhat obscured, and it becomes more so when the whole of Campbell's 224 stars are arranged under the Harvard equivalents of the Lockyer classes. Dr. Ludendorff therefore concludes the comparisons with the statement that when one arranges the helium stars of Campbell's catalogue under the Lockyer classification, there appears in the mean values of the absolute radial velocities of the several classes a distinct systematic difference. When one arranges the stars under the Harvard, or the Miss Maury, classifications, this systematic difference is not so clear as under the Lockyer arrangement.

Arising out of the question as to the reality of the observed difference, several suggestions as to its origin are made. The question of systematic error in the actual measuring is dismissed, and the evidence of streaming, disclosed by arranging the stars in four R.A. groups, is very small.

Dr. Ludendorff concludes with the suggestion that the wave-lengths in the spectra of helium stars vary with the condition of the star, and that this variation of condition may also be a function of Lockyer's arrangement of the stellar classes. Further, he makes the important suggestion that, as the Lockyer classification discloses this systematic difference, while the Harvard classifications do not show it so clearly, in the future discussion of a definite classification of the stars the classification which discloses this difference, possibly dependent upon spectral evolution, should receive most careful consideration. The elements of the spectral change, as shown in this discussion of the helium stars, are already incorporated in the classification, which by further natural development, and maybe slight modifications, may be made still more to portray the development of a star as it grows older.

William E. Rolston.

EDUCATIONAL CONFERENCES CONSIDERED IN RELATION TO SCIENCE IN PUBLIC SCHOOLS.[1]

II.

Laboratory Work in Schools and in Examinations.

In our previous article we gave an account of those discussions at the annual meeting of the Public School Science Masters' Association which dealt with the sequence of studies. The remaining discussions were concerned with the position of qualitative analysis and the relation between laboratory work in schools and the practical examinations of public examining bodies. Dr. E. B. Ludlam (Clifton) found the position of the teacher difficult, as he thought that modern methods were better than those in which qualitative analysis had figured so largely, but was obliged by the scholarship examinations and those for the higher certificate to retain too much of the older methods. At the same time, he found that boys were stimulated by exercises in the identification of substances, a process which enlarged a boy's chemical experience and gave scope to his individuality. He therefore advocated a study of "comparative chemistry," with early attention to metals and the periodic classification; in connection therewith, the boys should work out their own methods of identification. From the discussion on examinations, opened by Mr. G. F. Daniell, it appeared that there was a desire for more alternative questions, *i.e.* more options, in the practical tests, and Mr. H. Richardson suggested a number of useful variants from the ordinary type of question. In practical chemistry, the use of the blow-pipe and some work with unknown substances should be retained; but there had been too much refinement of analytical work, both qualitative and volumetric. Problems, accompanied by fairly full working instructions, would bring the examination work more into line with the work in the school laboratory. The opener, and several subsequent speakers, advocated closer relations between teachers and examiners, and agreed that it was important that the examiner should be present during the laboratory examination.

Mathematical Teaching.

It is usually unprofitable to deal with papers on mathematical subjects by means of short abstracts. We therefore give the programme of the meeting of the Mathematical Association, and attempt to review the present position in the light of the discussions.

The president's address, by Prof. E. W. Hobson, appeared in Nature of January 18. Mr. C. Godfrey gave some account of the work of the International Commission on Mathematical Teaching. Mr. G. St. L. Carson read a paper on some unrealised possibilities in mathematical education, and there was a discussion on the introduction of the calculus, in which Mr. C. V. Durell, Mr. A. W. Siddons, Dr. T. P. Nunn, and others took part.

Broadly stated, the papers threw light upon (1) the democratisation of mathematics; (2) the relation between the instrumental and the philosophical elements in mathematical teaching. Prof. Hobson's address makes clear what we wish to convey by (1), and we observed that the idea influenced most of the speakers. Prof. Perry and the Board of Education use the term "practical mathematics" in the sense of vocational mathematics, and Prof. Hobson had apparently the same idea in his references to "practical life." Where the president spoke of the "practical side" being overdeveloped he had in view laboratory exercises. By "instrumental" mathematics we mean the method of teaching which uses the utilitarian motive in order to lead the pupil to mathematical concepts. We put it that Prof. Hobson recognises the democratisation of mathematics as a welcome fact, believes that this justifies some, but not exclusive, use of the instrumental method, and lays stress on the necessity for combining with the latter considerable philosophical and deductive training. Mr. Godfrey told us that Italy had, more than any other country, continued to demand a philosophical treatment of geometry from young beginners, employing methods more rigorous than those of Euclid. Germany, on the other hand, had gone farther than any other nation in develop-

[1] Continued from p. 394.

ing the instrumental aspect. The Italians did not seem to be satisfied with their own results. The discussion on the calculus showed methods which had been successful in introducing this subject into schools (cf. Sir Joseph Thomson's laudatory remarks). The requirements of the physicist and engineer had been in view from beginning to end, but attention had been paid to the concepts of limits, differential coefficient, differential equation. In fact, mathematical masters in the larger schools were prepared to follow Prof. Perry in many of his reforms and extensions of their curricula, but part company with him when he asks them to eliminate philosophical considerations, as unsuited to boys. Mr. Carson went a stage further. He advocated a more philosophical treatment from the beginning of arithmetic, geometry, and algebra, in the order named, and would introduce pure mathematics—in the sense in which Bertrand Russell uses the term—to the older pupils. This he did because he believed that the modern theories of pure mathematics were destined to illumine our understanding of psychology, history, sociology, and economics, just as the older mathematics had thrown light on electricity, heat, light, and other physical sciences. He would teach mathematical philosophy as instrumental to human thought and social development, in that it shows the true relation between thought and experience.

Progress of the Societies.

At the business meeting it was reported that nearly all public schools are represented in the Science Masters' Association. The committee had been invited to assist the Army Council in connection with science examinations, and their advice had been utilised. The Oxford and Cambridge Joint Board had agreed to the request of the committee for extended time for practical chemistry. The General Medical Council had altered their regulations so as to admit a public school, under certain conditions, to "recognition as an institution where medical study may be begun."

The Mathematical Association has grown during the year, and now has 675 members and 200 associates, the increase of branch activity being worthy of remark. *The Mathematical Gazette* has been enlarged and made more useful to teachers, and the library is being made more accessible to members.

Exhibition of Apparatus.

There was a large and instructive display of apparatus in the common rooms of the London Day Training College, of which we are only able to give a few instances. Mr. D. Berridge provided a cheap, serviceable optical bench with vertical adjustments to the stands, while another felt want is supplied by the very handy electrolytic cell of the Rev. W. Burton. Mr. G. H. Martin's model volcanoes will be widely copied, and his dissociation model would be a useful adjunct to the college lecture-room. A carbon rheostat made by the Loretto boys appeared to be a serviceable instrument. We should like to see more evidence of boys' ingenuity and handicraft; its rarity suggests a weak point in the teaching, which it is quite possible is more apparent than real. A simple method of finding the surface-tension of a soap-film, shown by the Rev. S. A. McDowall, gave promise of considerable accuracy. Among the exhibits of business firms we noted more improvements and additions to apparatus of established repute than absolute novelties. Useful instruments for electrical and magnetic instruments, strong but cheap, were shown by Griffin and Sons, Philip Harris and Co., Becker and Co., Gambrell Bros., and others. We noticed a very good "wireless" set by Becker at ten guineas. Nalder Bros. have improved that originally excellent instrument the Ayrton-Mather universal shunt. Watson and Sons had a good display of microscopes, and their "H" stand offers more conveniences, combined with precision, than we have found in an extensive experience of Continental instruments. The laboratory fittings by Baird and Tatlock, the stills and ovens by Brown and Son, the lanterns by Reynolds and Branson, are well known, and are being constantly improved. Some gas-generators shown by Townson and Mercer are well suited to school use, and the foot-bellows, *without rubber*, supplied by Gallenkamp and Co. will appeal to many. The requirements for laboratory mathematics are admirably met by G. Cussons, Ltd., and we believe that the school apparatus of the future will follow the lead given by this firm in making use of sets of apparatus with interchangeable parts attached to truly-made substantial standards. They show a hand-microtome which is really efficient and easy to use. As many science masters work in remote districts, they took the opportunity to inspect the well-chosen books exhibited by Messrs. Arnold, Bell, Cambridge University Press, Macmillan, Methuen, Oxford University Press, and University Tutorial Press.

G. F. DANIELL.

BIRD-NOTES.

IN the second part of vol. ix. of the Transactions of the Norfolk and Norwich Naturalists' Society, Mr. J. H. Gurney records what is known with regard to the history of the stuffed specimen and egg of the great auk in the Norwich Museum. The egg, which is noteworthy on account of the well-preserved colouring of the markings, was presented to the museum in 1910 by Mr. James Reeve on his retirement from the curatorship. It was bought by Mr. Reeve from Mr. J. H. Walter, by whose father it was purchased about 1850 from Dr. Pitman. Beyond this its history cannot be definitely traced, although the suggestion has been made that it originally came from the Hamburg dealer J. G. Brandt. The stuffed bird was presented to the museum in 1873 by Mrs. E. P. Clarke, daughter of Mr. Edward Lombe, of Melton, near Norwich, to whom it previously belonged. Mr. Lombe bought it from Benjamin Leadbeater, the taxidermist, of Brewer Street, Golden Square, W.C., some time previous to 1822; but here its history ends. In spite of having probably been stuffed about seventy years ago, the plumage is still in fine condition.

In *The Emu* for October, 1911, the well-known ornithologist Mr. Sergius A. Buturlin gives a list of species of Australian birds which visit Siberia. The list includes no fewer than forty-eight species, of which, however, three are only occasional stragglers to the Far North. Of these some ten or eleven breed not only in Siberia, but likewise, although perhaps in slightly different forms, in Australia.

The Transactions of the Edinburgh Field Naturalists' and Microscopical Society for 1910–11 (vol. vi., part iv.) contains a paper on bird-migration in the Solway district, communicated by the late Mr. Robert Service six months before his death. In one passage the author emphasised the fact that every British bird, except the grouse and perhaps one other species, is, to some extent at any rate, migratory. "All the individuals of such a species as, for example, the robin, shift their quarters a few degrees north or south at the migration seasons. It will thus happen that at the northernmost limit of the distribution of such a species no birds of that species will be found in winter, while similarly, at the southern limits of its range, no birds of the species will be found in winter."

Later, the opinion is expressed, on several grounds, that the returns from lighthouses relating to bird-migrations are based on misleading data, as birds are never low enough to strike the stations except when the weather is very dark or thick, or when they are driven down by strong gales.

The feature of the December (1911) number of Witherby's *British Birds* is formed by three superb photographs of the black-throated diver, taken by Mr. O. G. Pike in the Outer Hebrides. The photographs were taken from a stone hut, built, with special precautions, near the nest. "The bird before me," writes the artist, "was absolutely unconscious of any danger, and it was really beautiful to watch her as she settled down upon her two eggs. At first she could not get comfortable, and I exposed a good many plates, but when she eventually settled it seemed impossible to move her."

The damage inflicted on trees and timber by woodpeckers forms the subject of Bulletin No. 39 of the Biological Division of the U.S. Department of Agriculture. From an economic point of view the author, Mr. W. L. McAtee, divides the group into true woodpeckers, which are mainly beneficial, and sap-suckers, which are very injurious.

Although some of the former do considerable damage to trees, and even to telegraph poles, they more than compensate these injuries by the destruction of insects, some of which belong to species eaten by no other birds. For the typical sap-suckers little or no defence is possible, as they feed largely on the juices and tissues of trees, and do not prey upon any specially harmful insects. In extracting the growing, or cambium, layer beneath the bark they frequently so damage the trees that they are weakened and crippled, or even killed, while the timber is in many cases rendered more or less useless. Two species of sap-sucker (*Sphyrapicus varius* and *S. ruber*) are so mischievous that their destruction is considered justifiable. It is added, however, that "as there are twenty species of woodpeckers in the United States, and only two of them are under indictment, great care should be exercised to distinguish the real offenders. When it is necessary to destroy sap-suckers, poison should be used, because of the small risk to other birds."

The "casual list" of British birds has been further augmented by the capture on October 30, 1911, at Fair Isle, of a male of the pine-bunting (*Emberiza leucocephala*). Mr. Eagle Clarke, who records the occurrence in the January number of *The Scottish Naturalist*, states that at the time of capture the characteristic chestnut of the head, neck, and throat was obscured by white tips to the features, which are worn off during winter. The colouring of the remainder of the upper parts is very similar to that of the yellow-hammer. The species is a native of Siberia, from the Ural to Amurland, but it winters in northern China, Mongolia, Turkestan, and the Himalaya, straggling to Turkey, Austria, Italy, and the south of France.

In the same communication Mr. Clarke records a sprosser, or thrush-nightingale (*Luscinia*, or *Daulias luscinia*) at Fair Isle in the spring of 1911. The species ranges from Denmark to S.W. Siberia, visiting E. Africa in winter. The upper parts are darker and more olive than in the nightingale, the tail is dark brown with only a tinge of rufous, and the feathers of the breast are darker, with a spotted appearance. The only other British occurrence was at Smeath, Kent, in October, 1904, but this has been regarded as doubtful.

Mr. Clarke likewise records Baird's sandpiper (*Tringa bairdi*), of which two previous British occurrences are known, at St. Kilda on September 28, 1911; while in a separate note in the same issue the woodchat-shrike is also added for the first time to the Scottish list.

Nor does this exhaust the tale of rare stragglers to Great Britain, for in the January number of Witherby's *British Birds* are recorded, for the first time, two examples of the American peregrine (*Falco peregrinus anatum*), the one taken in Leicestershire on June 14, 1891, and the other in Lincolnshire on September 28, 1910. They are the first British records for this race, which is characterised by its large size and dark plumage.

To the Journal of the South African Ornithologists' Union for December, 1911, Mr. Alwin Haagner contributes a second note on the presence of a deciduous hook at the extremity of each half of the beak in nestling honey-guides. The occurrence of these curious hooks in a second specimen, and that belonging to a different species, renders it certain that the first example was not a "sport."

To the January number of *The Zoologist* Messrs. F. J. Stubbs and A. J. Rowe contribute an article entitled "The Prehistoric Origin of the Common Fowl"—certainly a somewhat curious designation for a communication of which the pith is based on historical data. In place of the domesticated fowl having been evolved from the wild *Gallus bankiva* in or near India, and reaching Europe by way of Persia, whence it was carried first to Athens and then to Rome, the authors cite pictorial and other evidence to show that the bird was known to the Mesopotamians and Egyptians so early as about 4600 B.C., and from this and other evidence they arrive at the conclusion that its original home was probably in Central Asia. Finally, they state that "the evidence appears to indicate that the bird [*i.e.* the wild *Gallus bankiva*] was introduced to India by invaders—a race known as Dravidians—from the north-west at an unknown date, and that the species is now feral there." Such a suggestion is altogether unreasonable. It may be added that when alluding to the sheep of ancient Egypt, the authors make no reference to the work of Messrs. Lortet and Guillard on the mummified fauna of that country published in the Archives of the Lyons Museum.

Dr. Van Oort has favoured us with a reprint of an article from vol. xxxiv. of Notes from the Leyden Museum on bird-marking in the Netherlands, which was commenced in the spring of 1911. It is believed that 1165 birds, representing thirty-one species, were ringed during the year, out of which twenty-two had been recovered at the beginning of November last.

In *The Victorian Naturalist* of December, 1911, Mr. E. B. Nicholls records the marvellous mimicking power of the lyre-bird, as heard in the Bass Valley. The sounds imitated comprised the cry of the koala, or native bear, the notes or calls of seventeen different species of birds (including the alarm notes and whirring of the wings of a flock of startled parraquets), the creaking of the boughs of trees in the wind, and the "puffing" of locomotive engines.

R. L.

THE INSTITUTE OF METALS.

THE annual meeting was held in London on January 16 and 17. Owing to sudden illness, the president-designate, Prof. W. Gowland, F.R.S., could not attend, and his address on "Copper and its Alloys in Early Times" (of which we hope to give an account later) was read by the secretary, Mr. G. Shaw Scott. Sir Henry J. Oram, K.C.B., Engineer-in-Chief to the Royal Navy, occupied the chair.

Among the papers read the following may be mentioned:—

Mr. G. D. Bengough, in a paper on a study of the properties of alloys at high temperatures, described a series of tensile tests on selected metals and alloys. The tests were carried out at temperatures varying from the ordinary temperature to the neighbourhood of the melting points of the materials used. Unexpected results have been obtained. The curves showing the variation of mechanical properties with temperature show certain "mechanical critical points" in the neighbourhood of which the direction of the curves alters rapidly, and this phenomenon occurs even in the case of commercially pure metals, such as copper and aluminium.

In a paper by Mr. R. H. Greaves on the influence of oxygen on copper containing arsenic or antimony, experiments were described which were made to determine the influence of oxygen on certain mechanical and physical properties of copper containing either arsenic or antimony in quantities up to 0·5 per cent. With increasing arsenic the metal may take up more and more oxygen without suffering deterioration in its capacity for rolling. The action of oxygen on copper containing antimony is similar. The ductility was similarly affected by oxygen. Increase in oxygen from 0·15 to 0·4 per cent. causes a rapid diminution in elongation. Oxygen has little effect on the hardness until a limit is passed; above this the hardness increases rapidly. Measurements of electrical resistance show that oxygen diminishes the conductivity of copper containing arsenic, but increases that of copper containing antimony.

Mr. Philip's paper, on contributions to the history of corrosion: the corrosion of condenser tubes by contact with electronegative substances, was devoted to an examination of the relatively small number of cases experienced by the Royal Navy in which localised corrosion occurs in condenser tubes made of Admiralty composition. The causes of 90 per cent. of the cases of corrosion observed in the establishments of the Royal Navy have long been known. The main problems which remain to be solved are the explanation of the causes of rather less than 10 per cent. of the cases which are now observed, and, secondly, the devising of means of preventing these and all other cases of corrosion superior to the method of protector bars, as at present employed.

In a note on the nomenclature of alloys, Dr. W. Rosenhain raised the question of the nomenclature of non-ferrous alloys, and put forward some tentative suggestions to serve as a basis for discussion. Confusion in nomenclature

exists at the present time, particularly as regards such terms as "brass" and "bronze." A system of nomenclature was put forward in which alloys are classified according to the system of binary alloys to which they approximate most closely, and class names for such binary systems were advocated.

Prof. T. Turner dealt with the behaviour of certain alloys when heated *in vacuo*. It was observed, a year ago, that on melting brass *in vacuo* the whole of the zinc volatilises, leaving the copper. This separation is quantitative if the heating is not too prolonged and the temperature not above 1200° C. The behaviour of other copper-zinc alloys was therefore investigated. A sample of "poisoned" brass—*i.e.* brass containing iron, lead, tin, arsenic, and other impurities—was heated *in vacuo* at 1200° C., and the residue examined. All the zinc, lead, and arsenic, and a little of the tin, volatilised, leaving a residue of copper, iron, and most of the tin. It is suggested that heating *in vacuo* might be advantageously applied for the refining of crude copper, brass scrap, &c. "Hard" zinc may be refined by heating *in vacuo* to 500° C., *i.e.* to a scarcely visible red heat. Zinc distils readily in glass vessels *in vacuo*, the vapour being colourless and transparent. The zinc condenses in globules, having the appearance of mercury.

Prof. H. C. H. Carpenter described further experiments on the critical point at 470° C. in copper-zinc alloys. The so-called β constituent in copper-zinc alloys is to be regarded below 470° C. as a minute and uniform complex of α and γ particles. Even after six weeks annealing at 445° C. no coalescence of the particles has been observed in an alloy of exactly the eutectoid composition. When, however, a few crystallites either of α or γ are initially present in an otherwise pure eutectoid alloy, then, on annealing at 445° C., this stability is easily destroyed. The structural stability of the pure eutectoid alloy can be explained by supposing that, at the inversion temperature on cooling, the resolution of β into α plus γ takes place throughout the entire alloy almost, if not quite, simultaneously.

Mr. F. Johnson, in his paper on the effect of tin and lead on the micro-structure of brass, records the results of experiments made with the object of ascertaining the structural relations which exist between lead and tin when present in brass where the ratio of copper to zinc is 2 : 1. He strongly advocates a very thorough annealing of all cast material of the 70/29/1 and 62/37/1 compositions (Admiralty and Naval brass respectively) before subjecting it to rolling or drawing.

OXFORD METEOROLOGICAL OBSERVATIONS.[1]

WE are glad to see the appearance of the volume referred to below, containing as it does the meteorological observations made at the Radcliffe Observatory, Oxford, for the years 1900 to 1905 inclusive, because there has been difficulty in obtaining the necessary funds for printing. Fortunately the Radcliffe Trustees, by means of a grant of a special character, have been able to overcome this difficulty; and not only will the arrears of printing be made good, but, as the director remarks, "we hope before many months are past to be able to clear those off and in future to publish the results of our meteorological observations promptly in a regular annual form." This is really good news, because meteorologists—and there are now many of them—who discuss meteorological observations desire to include the most recent data, and in a great number of cases these are impossible owing to the values not being published. The meteorological observations made at the Radcliffe Observatory, some of which date from the year 1850, form a most valuable, continuous, and homogeneous series, so that it is most important that this series should be published as soon as possible. Even now the present volume goes only so far as the year 1905, so that the observations for the years 1906 to 1911 are still missing in a published form.

In recent years attention has been directed to the peculiar position the Radcliffe observations hold with regard to the large question of the Thames flow. It was found by Sir Norman and Dr. Lockyer that the rainfall at Oxford represented variations from year to year which corresponded closely with the variations determined from a large number of combined stations, and these corresponded in nearly every feature with the variations of the level of the Thames as recorded at the numerous gauges on the river. This fact showed that by simply taking the Oxford rainfall records alone a good approximation to the subsequent flow of the Thames could be gathered, because the natural flow of the Thames has a lag of four to five months on the rainfall. It is noticed in this report that weekly values of rainfall are communicated directly to the Thames Conservancy Board, no doubt in consequence of this relationship.

The volume is arranged on the same lines as that previously issued for the period 1892 to 1899, with the following important differences:—First, that the readings of the fine underground platinum thermometers, which were commenced in the year 1898 (October), and continued daily throughout the six years dealt with in this volume, have been omitted, as it is intended to publish them later in a separate form, with a full discussion of the results; secondly, that the tabulated daily results and monthly means derived from the photographic and self-recording instruments have been included; thirdly and lastly, that the results of the hourly readings of the barograph, thermograph, and hygrograph have also been incorporated in the volume, with a discussion of the mean diurnal inequalities in the readings of the three instruments for the period under consideration, and a comparison of these inequalities with similar quantities deduced for the period 1880 to 1887.

AMERICAN ARCHÆOLOGICAL PROBLEMS.

MR. ALFRED P. MAUDSLAY delivered his presidential address at the annual general meeting of the Royal Anthropological Institute on Tuesday, January 23. Mr. Maudslay said that even at the present day the idea that the origin of man does not form a fit subject for scientific inquiry has not yet entirely died out, and this feeling has militated against anthropology becoming a popular study. Meanwhile, the immediate and energetic prosecution of anthropological studies is of vital necessity, since the material with which this science deals is becoming rarer every year, as primitive customs yield to civilisation. The fact that man's physique is less subject to alteration gives a permanent value to the study of physical anthropology. An example of the far-reaching effects of a change in culture is, let us say, the introduction of writing, which has a democratic tendency, since it places the tribal law, formerly preserved in the memories of the elders, at the disposal of the younger members of the tribe. Upon the present occasion attention may be confined to certain points of the archæology of America, where there are traces of many extinct civilisations. The word civilisation is used for want of a better; such a people as the Aztecs, though civilised in some respects, were barbarous, or even savage, in others. In fact, our terminology requires revision, for the existence of a savage custom, such as cannibalism, does not necessarily imply a low stage of culture. Want of recognition of this fact has caused many misunderstandings between Europeans and the "barbarous" races. Such misunderstandings might be avoided by a knowledge of elementary anthropology, and this institute has not ceased to press upon the Government the advisability of establishing in this country an Anthropological Bureau, which would be of material assistance to colonial administration.

There is no better test of the antiquity of American culture than the fact that maize and other vegetable foods had been gradually evolved by patient cultivation from obscure wild plants. The indigenous nature of that culture is shown by the fact that they were unknown in other continents before the discovery, though their value to man led to their introduction all over the world immediately afterwards. The languages of America, moreover, bear a closer resemblance to one another than to those of the rest of the world.

In solving the many problems presented by America,

[1] "Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Six Years 1900–5." Under the direction of Dr. A. A. Rambaut, F.R.S. Vol. xlix. Pp. xx+304. (Oxford: Henry Frowde; London: Oxford University Press, 1911.)

where race has overrun race and culture succeeded culture, archæology is not self-sufficient, but it may often point the way to further research. For instance, at Ixkum, in northern Guatemala, a stone relief shows two typical Maya standing on two individuals of a totally different type. The latter probably represent a conquered race. Near the city of Guatemala stone figures have been discovered closely resembling this non-Maya people. Ruins in the neighbourhood bear an interesting resemblance in plan to those at the famous site of Teotihuacan in Mexico, but the site still awaits proper investigation.

Another point from which the antiquity of American culture may be argued is the distinctive nature of American art; but while general similarities exist all over Central and South America, local developments occur, *e.g.* at Mitla, which are not only *sui generis*, but are, apparently, accompanied by no remains which indicate how they were evolved. Certain motives appear to be almost universal, such as the serpent, and the *quetzal*-bird, which occur in various combinations, and also the water-plant, which is interesting as being the only vegetable form in American art. A few instances such as these show what a vast field for investigation is offered by America, the study of which has been rather neglected in this country. This year, in May, we shall be welcoming the International Congress of Americanists to London, and though we possess in England more pre-Columbian objects of interest than any other European country, it is the first time that we have acted as hosts to the leaders of American research.

THE USE OF PHOSPHATIC FERTILISERS IN FRANCE.

SOME years ago M. Risler took an inventory of the soils of France, classing them as complete if they contained sufficient food material to yield fair crops, and incomplete if they were markedly deficient in any particular food constituent. Out of a total agricultural area of 49,000,000 hectares, no fewer than 36,000,000 were deficient in phosphates, and could not be made to yield profitable crops without liberal dressings of phosphatic fertilisers—a state of affairs that was not the result of previous bad cropping, but of lack of phosphorus in the original rock material.

In order to make good this deficiency, French agriculturists use both basic slag and superphosphates, but very little of the rock phosphates so popular in America. More than a quarter of a million tons of basic slag are used annually on the grass land, especially where the soil is derived from granite and schists, while about one and a half million tons of superphosphate are used annually on the arable land, and a good deal of phosphate is also contained in the guano applied as fertiliser.

But, vast as these quantities are, they are insufficient, and consequently there has been a marked increase in the price of phosphatic fertilisers during recent years. The various factors coming into play have been recently analysed in an article by M. Hitier in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (No. 6, vol. cxv.).

Superphosphate, as is well known, is made by treating rock phosphate—an impure tri-calcic phosphate—with sulphuric acid, and in order to overcome transport and other difficulties, the sulphuric acid is usually made on the spot at the factory itself. Both the raw phosphate and the pyrites from which the sulphuric acid is made have increased in price; the world's consumption of phosphates, which was four and a half million tons in 1898, had in 1908 increased to ten million tons. The price of superphosphates in France has usually been lower than in England, but now that the French deposits of rock phosphate are giving out, it has been necessary to look elsewhere. At present nearly half of the world's supply comes from North America, North Africa, however, also furnishing a great deal. Other supplies come from the Pacific Islands and the north of France and Belgium.

Investigations have shown that dressings of phosphates not only raise the quantity of the crop, but also improve the quality. Müntz showed that dairy produce, particularly butter, of the finest quality was obtained only from pastures exceptionally rich in phosphates. More recently M. Paturel has traced a clear connection between the quality of wine and the supply of phosphates. Analyses of numerous samples during the last ten years show that the best wines are richest in phosphoric acid, of which they contain about 0·3 gram per litre, whilst the second, third, and fourth classes are successively poorer. Further, if the vintages for different seasons are arranged in order of their phosphoric acid content, the list thus obtained is almost identical with the order of merit assigned by the wine merchants.

THE CARBONISATION OF COAL.[1]

II.

HAVING gained an idea of the results desired in the manufacture of illuminating gas and furnace coke, we can pass on to the thermal conditions existing during carbonisation, and at the outset we are met by the difficulty that little is known as to the heat of formation of coal, and that a variety of opinions exists on this point.

It is evident that, as the composition of coal in a mine will vary not only in different seams, but even in the same seam, there is no definite composition, and that nothing can be known as to the heat of formation except by direct determination, which necessitates experimental estimations of so complicated a character that the introduction of errors is extremely likely to vitiate the results.

Probably the most valuable work done in this direction is to be found in a report presented by M. Euchène on the thermic reactions which occur during the distillation of coal, which is in the Transactions of the International Gas Congress in Paris, 1900, in which he determines the thermo-chemical data coming into play during the distillation of coal in the manufacture of gas, with careful estimations of the heat of formation of the products of the distillation as compared with the heat developed by the fuel needed for the distillation; that is to say, a balance is struck, showing on the one side the heat generated, and on the other the heat expended, the difference found representing the heat of the decomposition of coal.

Mahler also determined the calorific value of a coal and of the products obtained on carbonising it, and both these observers found that the calorific value of the coal exceeded that of the products—that is, that coal is endothermic, and that its decomposition evolves heat—but it is quite clear that in the determination of a factor of this kind, which is dependent upon the difference between two figures obtained from a highly complicated set of determinations, each with its own source of error, and all tending in the same direction, these will be borne by the resultant, and it is not surprising, therefore, to find that with a coal of the same type Mahler found the heat of decomposition to be +254·83 calories, whilst Euchène found it to be +63·51 calories.

In Mahler's work the result was arrived at by deducting the heat of combustion of the products from the heat of combustion of the coal, whilst Euchène's determinations were obtained by taking the difference between the heat supplied and the heat consumed during distillation, so that the difference between the two would be likely to be increased by errors leading in opposite directions.

M. Euchène has determined in this way the heat liberated during the distillation of three types of coal, these results showing in a striking way that the heat liberated increases in nearly regular ratio with the amount of volatile matter in the coal, and that the more oxygen the coal contains, the more endothermic its reaction, a fact which points clearly to its being the oxygen-bearing compounds in the coal which give it its endothermic character.

It seems likely that when the oxygen in the coal falls below 3 per cent., all endothermicity will disappear, or at any rate become negligible, whilst with gas coals of the type most used in England, containing about 32 per cent. of volatile matter and 7 to 8 per cent. of oxygen, it will approximate to 250 calories or 450 B.Th.U. per pound of coal, but all the evidence as to this property in coal is of an unsatisfactory character.

When a coal is carbonised, it decomposes into gases

[1] From a course of Cantor lectures given at the Royal Society of Arts in November and December, 1911, by Prof. Vivian B. Lewes. Continued from p. 368.

and vapours, leaving behind the solid coke, and heat is used up in bringing about the change of state. When 1 lb. of coal is decomposed in the retort, the heat used up in the decomposition and distillation amounts to 462 B.Th.U. over and above the heat due to endothermic reactions. The heat withdrawn from the retort by the hot gas and vapours amounts to 324 B.Th.U., and the heat in the red-hot coke when it is drawn accounts for another 442 B.Th.U., so that the heat that has to be actually supplied for the carbonisation is 462+324+442=1228 B.Th.U.

The losses in the setting, however, exceed this, and in an ordinary horizontal bench would be 1463 B.Th.U. escaping with the flue gases, 398 B.Th.U. lost to the air by radiation and convection, and 23 B.Th.U. in the ash, making in all 1884 B.Th.U.

The thermal value of the reactions in the retort will remain the same whether the distillation be carried out in a horizontal, vertical, or inclined retort, in a coke oven or a chamber, and it is chiefly in the setting that the economies have been made which have reduced the carbonising fuel to the figures attained in modern practice.

In the horizontal retort setting quoted above, the total heat used would be 1228+1884=3112; now, 1 lb. of gas coke gives an average of 14,200 B.Th.U. in its combustion, so would give enough heat to carbonise 4·5 lb. of coal, or, in other words, the coal would require 21·9 per cent. of its weight of coke to carbonise it, whilst if the whole of the heat of combustion could be used in the retort, 8·6 per cent. would be sufficient.

A fair idea of the economies that are possible can be obtained by stating the heat used in the setting and retort in percentages:—

		B.Th.U. per lb	Per cent. of heat used	
Used in retort	1. Decomposition and distillation ...	462	15·7	39·3
	2. Escaping in gas and vapours	324	10·4	
	3. In hot coke ...	442	13·2	
Used in setting	1. Flue gases ...	1463	47·2	60·7
	2. Radiation and convection	398	12·8	
	3. Ash	23	0·7	

so that 39·3 per cent. of the heat is used in the retort, and 60·7 in the setting, the item which overshadows all others being the 47·2 per cent. which escapes up the chimney in the hot flue gases.

It is evident that the first step towards economy is to be found in a better utilisation of the heat in the setting, so as to abstract so far as possible the heat from the products of combustion, and this is done by regeneration, which reduces the flue gases by more than 300° C. in temperature, and brings down the loss due to this item from 47·2 to 25·2 per cent., whilst feeding the producers with red-hot coke from the retort effects a further economy, with the result that the fuel used falls from 21·9 to 14·8 per cent. and even lower.

Under these conditions the percentage of heat used in doing the work of carbonisation would be largely increased, and the chart would be as follows:—

Used in retort	1. Decomposition and distillation	21·4	54·1
	2. Escaping in gas and vapours...	13·8	
	3. In hot coke	18·9	
Used in setting	1. Flue gases	25·2	45·9
	2. Radiation and convection ...	19·9	
	3. Ash	0·8	

so that more than one-half the heat is utilised in work.

In the most modern practice results as low as 10·24 per cent. of the weight of the coal carbonised have been quoted, whilst in vertical retorts and chamber carbonisation 12 to 15 per cent. is the usual figure, these advances being made by utilising hot coke in the producers, more perfect regeneration, and reduction of the radiation.

The factor which endows all carbonisation problems with especial difficulty is that we are dealing with a body of such varying composition that no two samples are alike, whilst the conditions under which we are decomposing them vary from minute to minute.

The conduction of heat through a substance like the walls of a fireclay retort is a determination fraught with many troubles, as the conditions existing in a retort heated in a bench are totally different from those that can be obtained in making experimental determinations in a laboratory. In any calorimetric determination the one side of the test-piece is continuously cooled by the calorimeter, whilst the heat poured into the other side is very different in effect to the mass of heated material existing in the flues surrounding the working retort.

The rate at which heat is transmitted under working conditions depends upon the degree of heat in the flue and outer walls of the retort, the higher the temperature the more rapid being the transmission, whilst the difference between the temperature of the outer and inner skin of the retort is a factor of the greatest importance; the greater the difference, *i.e.*, the cooler the inner skin and the mass in contact with it, and the hotter the outer skin in the flue, the more rapidly will the heat pass. Again, the rapidity of transmission varies with the character of the fireclay, with its porosity, and with the temperature and length of time for which it has been baked, so that it is impossible to give any definite figure as to the rate of conductivity or transmission which shall hold good in all cases. Determinations based upon the rate of transmission at comparatively low temperatures may be discarded at once as valueless, but Mr. G. Beilby determined the conducting power of firebrick, and came to the conclusion that one square foot of firebrick, one inch thick, passed 6·59 centigrade pound units, or 11·86 B.Th.U. per hour for each degree centigrade of difference between the sides of the brick, when these differences were of the magnitude of 200–300° C.

My own opinion is that at the ordinary working temperature of a retort under gasworks conditions the amount of heat transmitted approximates to 25 B.Th.U. per square foot of surface for each 1° C. difference in the temperature of the outer and inner surface of the retort, and that this is not seriously affected by the thickness of the fireclay, as conduction is so slow with a retort 3 inches thick that it is probably only the internal portion that is cooled to any great degree when a fresh charge is fed into a properly heated retort, and the mass of fireclay acts as a store of heat, so that the heat has only a short travel.

In a horizontal retort ready for charging, the temperature of the inner walls will approximate to 1000° C. (1832° F.), and the flue temperature to 1100° C. (2012° F.), and the fireclay walls of the retort will conduct the heat at a rate which approaches to 25 B.Th.U. per square foot per hour for each degree centigrade difference in the two surfaces, so that during the first two hours, when the average temperature of the inner side of the retort walls, cooled by the charge and by the retort having been opened, will not be more than 800° C. (1472° F.), the amount of heat passing through the walls into the charge will be $25\times(1100-800)=7500$ B.Th.U. per square foot of surface, whilst by the fifth hour, when the inner side of the wall of the retort has risen to 950° C. (1742° F.), the amount passing will be—

$$25\times(1100-950)=3750 \text{ B.Th.U.},$$

or only half the amount passed in the earlier period, the average being approximately 5625 B.Th.U. per hour, which, taking the heat units needed for the actions taking place in the retort as 1228 B.Th.U. per lb., gives a carbonising value for a six-hour charge of 12 tons per 1000 square feet of retort surface.

The diminution in the quantity of heat passing through the walls of the retort during the last stages of carbonisation does not affect the rate at which the still uncarbonised core of coal is being heated, as the envelope of coke surrounding it has reached nearly the same temperature as the walls of the retort, and forms a store of heat, whilst in the carbonising mass during the first part of the distillation the volume of gas evolved is so large that it carries off from the contents of the retort a large proportion of the heat, and so keeps down the temperature of the mass until the later stages of the carbonisation.

It has become the custom to speak of the temperature of carbonisation being high merely because the temperatures in the flues and in contact with the walls of the retort are high, and to speak of the products of high

temperature distillation as if the coal had been carbonised at the temperature existing on the retort surface.

It is quite clear, however, that, coal being a bad conductor of heat, and coke a worse one, it is only the layer of probably less than an inch thick that is carbonised at anything like the retort temperature, and that the remainder of the charge is distilled at a slowly rising temperature, which attains its maximum only after the volatile products have been practically all driven off.

The real distinction between high heats and lower flue temperatures is that the higher the temperatures employed, the thicker and hotter will be the layers of coke which the gases and vapours have to traverse in their escape from the inner portions of the charge, and the greater will be their exposure to radiant heat and contact with the highly heated surfaces of the retort in their outward passage from the carbonising mass; the products of the primary action are, in fact, being subjected to secondary decomposition under conditions we neither know nor can control, and this is one of the weakest points in our methods of carbonising for the production of illuminating gas.

We make elaborate tables of the composition of gases and tars produced at various distillation temperatures, but the only information that they give us is what is left undecomposed under unknown and varying conditions, the only certain factor being that the heat was nowhere above that which we are pleased to call the temperature of distillation.

It is evident that if these variations exist in the temperature at which the coal is distilling in the comparatively small charge in the gas retort, they must be accentuated when one comes to deal with carbonisation in bulk as practised in oven and chamber settings, as not only is the travel of the gases and vapours through the red-hot coke much longer, but the rate at which the heat is conducted through the carbonising mass becomes slower as the bulk of the charge increases, whilst the temperature in the crown of the oven during the first half of the time is higher than is found in the gas retort, and this also applies to the temperature in the top layer of the coke.

If the coal is carbonised in a 6-inch diameter tube filled so that the heat shall be penetrating from every side, there is an almost immediate rise in temperature throughout the mass, owing to the hot gases and vapours passing through the interstices between the pieces of coal, and the coke attains its maximum temperature at the rate of about one inch per hour, so that in three hours, with a wall temperature of 1000° C., the centre of the mass would be at about 950° C., and the carbonisation would be finished; if, however, the tube be increased to 12 inches in diameter, the rate of conduction is reduced to 0·5 inch per hour, and the same thing takes place with a flat chamber retort heated from the sides, so that it would take about twelve hours to complete the carbonisation; whilst with further increase in the width of the chamber the rate of travel of the heat grows still less, the passage of the heat being still slower as the distance between the walls of the chamber gets greater.

The result of this is that in by-product recovery coke ovens and large chamber retorts the period of carbonisation becomes very long, and the gas has to pass through so much hot coke that the illuminating power is reduced to nine or ten candles.

These rates of passage of heat apply only to vertical retorts or chambers, the sides of which are heated, as bottom heat penetrates the mass rather more quickly owing to convection coming to the aid of conduction, and the upward flow of heated gases raising the temperature in advance of the conducted heat.

Moreover, the rate at which the heat travels in the carbonising mass depends to a great extent on the initial temperature employed, the figures given being attained only when the flues and outer walls of the retort or chamber are heated to about 1100° C. (2012° F.), but if the flue temperature is lowered, the transmission of the heat becomes lower, and a longer period, therefore, is required for the complete carbonisation, the time taken being nearly inversely proportional to the temperature; so that if in a 6-inch tube with a wall temperature of 1000° C. (1832° F.) it takes three hours to complete carbonisation, it would take six hours to do the same work with a wall temperature of 500° C. (932° F.). Consequently, in making low-temperature coke, such as coalite, in tubular retorts $5\frac{1}{2}$ to $6\frac{1}{2}$ inches diameter, it takes four hours to drive off two-thirds of the volatile matter that is in the coal.

The temperature of the coke or coal through which the gas and tar vapours have to pass, and the length of travel they have in reaching the exit from the retort or chamber in which carbonisation is proceeding, are two of the most important factors in determining their decomposition, as it is these which give rise to the secondary reactions that largely determine the final composition of the gas and tar.

Valuable pyrometric observations on the temperatures existing in charges of varying size have been made by Mr. Bond, of Southport, and other observers, from whose work we can deduce the following results as typical:—

If an ordinary D-shaped horizontal retort, 18 to 20 inches wide and 15 inches high, has a 6-inch charge fed into it, the space from the apex of the crown to the top of the charge will be 9 inches deep. If now thermocouples properly protected are placed (1) at the bottom of the charge, (2) in the centre, and (3) at the top of the charge, we can gain a good idea of the way in which the heat is acting on the coal.

With full heats the coal at the bottom of the retort rapidly heats up, and in fifteen minutes has reached 700° C. (1292° F.), after which its rise in temperature slows down, and it takes two hours to reach 800° C. (1472° F.); after this it heats more rapidly, and attains 1000° C. (1832° F.) at the end of four hours, and then there is practically no rise in the last two hours of carbonisation. The temperature at the top of the charge rises more slowly, and by the end of the second hour is only 740° C. (1364° F.), or 60° cooler than the bottom, and remains at a lower temperature throughout the whole carbonisation. This is not to be wondered at, as although the top flue of the setting is 1150° C. (2102° F.), and the bottom flue barely 1100° C. (2012° F.), the coal at the top of the charge is being heated largely by radiant heat acting across a considerable gas space, whilst the bottom of the charge is in direct contact with the heated bottom, and is taking in heat by conduction.

The thermo-couple in the centre of the charge throws most light upon the course the distillation is taking, and we discover that so great is the heating effect of the gases and vapours passing up from the hot zone at the bottom of the retort that at the end of the first hour the temperature is only 30° below that of the bottom, 730° C. (1346° F.), whilst in two hours it is at the same temperature, and then falls slightly below it for the rest of the time, the rush of hot gases from the bottom having ceased, and the temperature of the top of the charge equals the centre only after the fourth hour.

Now the fact that differences in temperature are so small throughout the mass, and that during the whole of the period when the bulk of the gas is being evolved the centre of the charge is hotter than the top, points to the gas forcing its way through the pasty mass of distilling coke upwards into the space below the crown of the retort, where it is baked by radiant heat from the mass of fireclay at 1050° C. (1922° F.), and the retort walls at 1050° C. and the coke at from 700° to 1000° C. (1292° to 1832° F.) are also in surface contact with it.

The passage of the gas through the pasty coke causes considerable swelling during the first hours of distillation, and when the shrinkage in the charge of coke takes place during the last two hours, the top portion, presumably carbonised by radiant heat from the top of the retort, shrinks over a smaller depth than the bottom and large portion, so that when the charge comes to be drawn there is found to be a fissure running horizontally between the upper and lower portions, but nearer to the top, from which vertical cracks branch to the top and bottom of the charge.

We are at present dealing only with the thermal conditions existing during carbonisation; but when we come to study the more chemical side of the actions taking place we shall see that such methods are the most brutal form of distillation—high heats and small charges certainly mean

high makes of gas, but got at the expense of all the other by-products, and bringing in their train all the troubles of stopped ascension pipes, carbonised retorts, ruined tar, and poor coke. If instead of using a 6-inch charge in such a retort it be filled with coal as nearly as a horizontal retort can be filled, that is, to within 2 or 3 inches of the apex of the crown of the retort, and the same temperatures as before are used in the setting, you approach to the same conditions that obtain in vertical retorts, which are entirely filled, and quite different results are obtained.

The improved results are by most observers ascribed to the doing away with the baking chamber above the charge, radiant heat being credited with the formation of free carbon and naphthalene, which have been the chief curses that have accompanied the raising of temperatures with small charges to increase the gas volume obtained.

The determination of temperatures as before in the charge shows that filling the retort does a deal more than this, however; in the first place, in order properly to carbonise the charge, the heating has to continue from eight to twelve hours instead of six, and the heat is poured into the charge in a much more even manner, the rise in temperature at both top and bottom being equal throughout the distillation, and with the top temperature always about 100° C. more than the bottom, truly reflecting the difference in temperature between the top and bottom flues of the setting. Owing to the thickness of the charge having been doubled, the heat advances more slowly into the mass, rendering the coal semi-fluid and pasty in front of it, and so forming the whole centre of the charge into a tube, through which a large proportion of the gas finds its way down to the mouth of the retort without having been overheated in the crown.

That this is the true explanation is shown by the thermocouple in the centre of the charge, which during the first 5½ hours of the distillation rises slowly in temperature at about the same rate as the outer portions, but on a plane 500° C. (932° F.) below them, whilst after this period the central heat rises rapidly, and the same temperature as exists at the bottom of the charge is attained in the eighth hour.

The gas is improved because only a small portion has to run the gauntlet of overheating; the tar is improved because a considerable proportion is made at a lower temperature; the coke is improved because in the earlier half of the distillation a good deal of tar has condensed in the cool zone, and as the temperature rises the more volatile portions redistil, but the least volatile remain and get decomposed only in the last hour of carbonisation, increasing the gas yield, the factor for which the gas manager at the present time seems prepared to make any sacrifice.

It must be clearly borne in mind that the possibility of filling a horizontal retort to within 3 inches of the crown, although suggested by Kunath in 1885, is a comparatively new condition, which could be achieved only by the introduction of discharging machinery that would push the charge of coke out of the retort, and that, so long as we were dependent upon hand labour to draw the charge, it was impossible; now, however, the introduction of vertical settings allows a more complete filling of the retort by gravity and easy discharge, so that the question of the route taken by the gas in its escape from the carbonising mass is receiving its full share of attention; and opinions on the subject are by no means unanimous.

Dr. Bueb, to whom we owe the inception of the Dessau vertical retorts, is strongly of opinion that the largest bulk of the escaping gas finds its way through a cool core in the same way as it undoubtedly does in a well-filled horizontal retort; others favour the theory that the major portion passes up the sides, whilst Dr. Harold Colman and many others agree that, as the pasty area of the decomposing coal works its way inwards from the walls of the retort to the centre, gas escapes on both sides of it, so that a portion goes up the centre and the remainder through the hot coke or up the walls of the retort. What proportions exist between the gas that takes the cool route and that which is forced to pass through the hot coke cannot be exactly determined, and would vary with every kind of coal; but what we do know, beyond doubt, is that a large volume of the richest gas comes off from all coals when first heated, so that a large evolution of primary gas will be on the inside of the tube of semi-fused coal, whilst another factor which would tend to make the gas take the inner route is that any passing back into the hot zone would be expanded by the temperature, whilst the still pasty coke would offer more resistance to the passage of the gas than the coal, so that pressure would be highest on the hot side and lower on the cool, the probabilities therefore being that, so long as the central passage is unimpeded, the major portion of the gas passes up the centre. The analyses of the gases, however, all show that far too much cracking of the rich hydrocarbons has taken place.

If we distil coal at a fixed temperature, as has been pointed out, we know that in the distillates we have the volatile products yielded at all temperatures below the one employed, and such secondary products as have been formed by further decompositions or by interactions between the primary products at or below that temperature, so that if we distil coal in bulk at the lowest temperature at which volatile matter can be driven out from the coal, the analyses of the products will give us the maximum of primary products with the minimum of secondary, and we shall obtain the best possible data for forming an opinion as to the composition of coal, on the one hand, and the course taken by the interactions and decompositions in the secondary actions.

In the experiments that led to the introduction of coalite it was found that 420° C. (800° F.) was the lowest temperature that could be employed successfully, and many thousand tons of coal have been distilled at about this point, say, from 400° to 500° C.

Under these conditions a fair gas coal containing 30 to 33 per cent. of volatile matter will yield 68 to 70 per cent. of low-temperature coke containing 10 to 14 per cent. of volatile matter, and a volume of gas varying from 3000 to 5000 cubic feet, according to the coal used, having a composition approximating to—

Hydrogen		27·5
Saturated hydrocarbons—methane ...	48	
higher members	10·1	
	——	58·1
Unsaturated hydrocarbons...		3·0
Carbon monoxide		7·3
Carbon dioxide		2·5
Nitrogen		1·6

The gas before iron purification contains about 1·8 per cent. of sulphuretted hydrogen.

The low-temperature gas, of course, varies with the coal used, and the hydrogen is often below 18 per cent., and the saturated hydrocarbons up to 68 per cent.; but the marked feature of the gas is that it contains hardly any benzene vapour, and owes its illuminating power to a small percentage of ethylene, and chiefly to the gaseous members of the paraffin series (mostly ethane), and also that the percentage of hydrogen is low, very rarely reaching the amount present in the above sample, whilst bisulphide of carbon likewise is very low.

This I pointed out in the last course of Cantor lectures which I gave in March, 1908, and it has since been confirmed by the work of Porter and Ovitz, White Park and Dunkley, and Burgess and Wheeler.

The tar also varies with the coal used, and is sometimes as high as 23 gallons per ton, and in most cases averages 20 gallons.

The low-temperature tar is as distinctive in its characteristics as the gas. It has a specific gravity of about 1·075, is very liquid, and contains an abundance of light solvent oils, very low aromatic hydrocarbons, very little phenol, but large quantities of cresol, no naphthalene and very little anthracene, whilst the free carbon is, as a rule, below 2 per cent.

The very low percentage of benzene in the light oils is made up for by the presence of paraffins, such as hexane, heptane, and octane, whilst there are also present considerable quantities of that curious group of hydrocarbons known as naphthenes or hexahydrobenzenes, which play so important a part in Russian petroleum.

As before mentioned, carbolic acid occurs in very small quantities, but its higher homologues, such as cresylic

acid, &c., occur in much larger quantities than in coal tar, and there are also present quantities of polyhydric phenols or other esters of the type met with in coal tar, which form resinous masses difficult to investigate. The pitch left as a residue amounts to about 40 per cent. of the tar, and is of very fine quality, owing to the practical absence of free carbon.

When low-temperature coke that has been formed with the evolution of 5000 cubic feet of 22 candle-power gas, as measured by the No. 2 Argand, is further heated to a high temperature, it evolves nearly as much gas as it did before, and the composition of this gas is approximately—

Hydrogen	71·13
Saturated hydrocarbons	18·26
Unsaturated hydrocarbons	0·52
Carbon monoxide	6·30
Carbon dioxide	2·09
Nitrogen	1·70

The gas is practically non-luminous when burnt alone, but has a heating value of 447 B.Th.U. gross.

It seems clear from these experiments that in the distillation of coal for gas there are three distinct sources which give the final product:—

(1) The primary gases evolved from the coal, and distilled out as the advancing temperature travels through the mass.

(2) The gas evolved by the decomposition of the heavy tar or pitch left in the coking mass.

(3) The gas produced by secondary actions, and contact of the primary gases and vapours with the hot coke and walls of the retort.

It now becomes possible to trace, roughly, the actions taking place in the destructive distillation of a gas coal. Up to about 450° C. the products are chiefly primary:—

Humus bodies		Resin bodies and hydrocarbons
Carbon—		
Water	Gases	Methane
Carbon monoxide		Ethane
Carbon dioxide...		Propane
Hydrogen ...		Butane
Methane ...		
Coke and pitch—	Liquids	Pentane
Watery tar ...		Hexane
		Heptane
		Octane
		Nonane
		Hexahydrides
		Oxygenated hydrocarbons like cresylic acid and more complex bodies

About 400° to 450° C. the secondary actions start, the saturated hydrocarbons split up into unsaturated and simpler members of the saturated series, the hexahydrides shed hydrogen and give aromatic hydrocarbons, the tar thickens and alters in character, and synthetic actions start, cresol and hydrogen form more toluene, carbolic acid and carbon yield carbon monoxide and benzene. About 900° C. the degradation of all the hydrocarbons and other oxygenated bodies is proceeding, and finally the mixture of the results of endless actions and reactions yields us the high-temperature gas and tar, the mixture being diluted with the carbon monoxide, hydrogen, and methane yielded by the decomposition of the pitch residues in the soft coke, which leaves the hard coke behind.

With a good Durham coal, capable of yielding 11,000 cubic feet of gas and 10 gallons of tar per ton when distilled under ordinary conditions at a temperature of about 1000° C., it is found that on carbonising at 600° C. it yields only 5000 cubic feet of gas, but 22 gallons of tar per ton, and the residue, on continuing the distillation at 1000° C., yields a further volume of 4500 cubic feet of gas, but no tar, so that removing the gas first formed and the tar vapour from the secondary reactions induced by high temperature has reduced the gas yield by some 1500 cubic feet per ton, and increased the tar yield by 12 gallons; and an examination of the tar shows that the 12 gallons gasified by direct distillation at high temperature consist of the lighter portions of the whole of the tar, which at this temperature is capable of producing 1200 cubic feet of gas, leaving 300 cubic feet to represent the volume gained by degradation of gaseous hydrocarbons and deposition of free carbon, of which the high-temperature tar contains 25 to 35 per cent.

It may be taken, in round numbers, that when 11,000 cubic feet of gas are obtained per ton of such a coal, 45 per cent. of the volume is from the low-temperature distillation, 42 per cent. from the residues left in the low-temperature coke distilled at a high temperature, and 13 per cent. from the various secondary actions and tar.

When tested by the No. 2 Argand, the low-temperature gas has a candle-power of 22; the gas from the pitch in the coke is nearly non-luminous, giving not more than 2½ to 3 candles, but when mixed with the rich gas in the proportions of 45 of the latter to 41 of the former gives a 16 to 17-candle gas; whilst the gas from the tar and the secondary actions is 10-candle gas when tested alone, and when mixed with the others brings down the total candle-power to 14 to 15.

In the new methods of carbonisation, where the makes approximate to 13,000 cubic feet, the improvement found is entirely due to the free escape without over-heating of the products from the first two-thirds of the coal carbonised, whilst the extra volume is obtained from the complete degradation of the products from the remaining third, and that this is so is shown by the methane in the gas. In all fair coal gas in which there has been no over-degradation, even if you have been getting 11,500 cubic feet per ton from light charges, the methane will be about 34 to 35 per cent. of the gas; but notice the products of the new carbonisation, and you will find plenty of samples with only 28 per cent., and some even lower.

In considering the ultimate effect of pushing temperatures to the highest possible extent, it is as well to consider the amount and value of the gas and coke that could possibly be obtained from an ordinary coal.

If we took a coal of the composition—

Carbon	80
Hydrogen	5
Oxygen	10
Nitrogen and ash	5

and were to carbonise it in an inverted vertical retort with the coal fed in by a ram at the bottom, so that the gas and vapours had to traverse a column of 10 feet of coke at 1000° C., contact would decompose all the gaseous and volatile compounds to hydrogen and carbon monoxide, and we should obtain—

Coke	15·27 cwt.
Hydrogen ...	22,400 cubic feet = 77·87 per cent.
Carbon monoxide	6,366 cubic feet = 22·13 per cent.
	28,766 cubic feet

that is, you would rather more than double the volume of gas; but it is a non-luminous gas of the same thermal value (gross) as water gas, and not worth more than the 3½*d.* to 4*d.* a thousand that you could make water gas at by one of the newer processes.

Now this is exactly what is done in all the new processes directly the cool passage for escape of the primary gas gets tar-logged, and the gas from the remaining coal is driven through the red-hot coke and along the sides of the retort. Under these conditions some 3500 cubic feet of 22-candle gas are obtained, whilst there is a free, cool passage for its escape; and after that is closed the remaining coal yields by complete degradation of the tar and hydrocarbons 9500 cubic feet of hydrogen and carbon monoxide.

The limit of volume in gas-making, if not already reached, is fast being approached; economics are day by day getting more difficult to make; coal is not likely to cheapen; and all this means that the chance of considerable reduction in the price of gas is getting less and less. If the price of gas could be reduced in our large cities to the price charged at Widnes, the consumption of gas could be economically increased, and for power and heat gas would hold an unassailable position; but this can never be done in existing circumstances, because even if the gas could be made at the necessary price, the increased output of coke would outrun the demand. If, however, the companies would only live up to their titles of "Gas Light and Coke Companies," and bestow as much care on the

coke as on the gas, and cater for the supply of a good domestic fuel at the price of coal, instead of treating coke purely as a by-product, the demand for it would soon reach a point that would enable the desired reductions in the price of gas to be made. There is no need to fear as to the other by-products; the output of sulphate of ammonia could be doubled without affecting the market, and a good tar will look after itself; it was high heats that ruined the tar market, and with the demand for tar increasing for road work, no flooding of the market need be feared.

During the last few years the statement has several times been put forward that "as the gas manager's end and aim is gas, it is his duty to obtain the greatest volume of gas possible per ton of coal"; but with this I venture to disagree. The gas manager's duty is to obtain the greatest possible value per ton of coal, and until every industry dealing with coal recognises that in this respect its aim is the same, little economy will be possible in our rapidly diminishing store of coal.

The pressing of temperatures in carbonisation to higher and higher degrees with the old conditions of lightly charged retorts has given larger yields of gas, but it has loaded the gas with carbon bisulphide, depreciated the coke, and ruined the tar; and one of the chief claims for the adoption of the full-charge horizontals and intermittent vertical retorts for carbonisation is that they have improved the character of both coke and tar.

As I have shown, this is due to a certain proportion of the gas and tar vapour coming off through the cool core and so escaping over-cracking, but it can be only a partial improvement; whilst, so far as the coke goes, the nearer it approaches metallurgical coke the less it is fitted for a domestic fuel. True it is, that where the coke has been made harder and brighter the gas manager's market has improved; but it has been for use in furnaces, manufacturing processes, and for producers that the increased demand has been felt, and not for domestic use.

Even for the heating of furnaces the coke made at extreme temperatures is not so good as when the heats were slightly lower; and in Germany this is beginning to be recognised, and Körting, in a paper read this summer (1911), points out that the inclined settings, which used to work with 12 per cent. of fuel, now require fully 16 per cent., an increase due partly to higher temperatures, but largely to more highly carbonised coke.

Already the strides forward which gas has made as a domestic fuel are telling the tale in our atmosphere, and the yellow fogs of the last century are getting rarer; and if coke could be made a domestic fuel by leaving in it 6 to 8 per cent. of volatile matter to facilitate ignition and give a flame, the gasworks of the country could command the fuel market.

Remember that the sale of gas cannot be pushed beyond a certain point without overstocking with coke; the sale of both *pro rata* must be pushed, and if only you could be persuaded that this is the right road, you would be backed up by the smoke reformers and the public, and find yourselves able to sell a fuel coke at the price of the best coals.

I have shown that the factor for which you ruin your coke as a domestic fuel is about 3000 cubic feet of gas of the same value as blue water gas; the 3000 cubic feet of gas left in the coke would be worth four or five shillings a ton on the selling price, and the cost of replacing it by water gas would be about one shilling, whilst the creation of a large domestic market would enable a reduction in the price of gas to be made that would still further increase its use as a fuel.

Now I am sure in my own mind that these are the lines the gas industry should consider seriously, and that the advances in the next ten years must be an endeavour to get nearer to the ideal of carbonisation and to improve both gas and coke.

In a course of lectures such as these, four seems an ample allowance at the commencement—and probably to the audience more than ample at the end—but I realise only now how miserably inadequate the time has been for the expression of the matter I desired to bring before you, and can only hope that some of the points, controversial though they may be, will prove helpful in considering the carbonisation of coal.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE committee formed to promote a scheme for providing a college of university rank at Brighton has resolved that the scheme shall be one for establishing a constituent college of London University for the county of Sussex, the subjects to be arts, sciences, engineering, and pedagogy in the first instance, but medicine and law to be undertaken later.

THE Old Students' Association of the Central Technical College is organising a dinner to celebrate the election of Prof. W. C. Unwin, F.R.S., as president of the Institution of Civil Engineers. The dinner, which will be held at the Criterion Restaurant on Saturday, February 10, is intended to be a gathering of old students of the Central Technical College and Prof. Unwin's students at Coopers Hill. The chair will be taken by Mr. W. Duddell, F.R.S., president of the Central Old Students' Association. Tickets may be obtained from Mr. G. W. Tripp, 4 Fairfield Road, Charlton, Kent.

SEVERAL gifts to American universities are announced in the issue of *Science* for January 12. Mr. Jacob H. Schiff has given 20,000*l*. to Cornell University to promote studies in German culture; the 200,000*l*. fund for the further endowment of the medical school of Western Reserve University has been completed; and De Pauw University has just brought to a successful close the campaign to raise 80,000*l*. to meet the conditional gift of 20,000*l*. from the Rockefeller Educational Board. The subscriptions amount to a little more than 88,000*l*. This will make the productive endowment of the University something above 200,000*l*.

THE late Dr. R. D. Roberts, whose death occurred on November 14 last, left estate of the gross value of 10,024*l*., of which the net personalty has been sworn at 6021*l*. He bequeathed the ultimate residue of his property "to the University College of Wales, at Aberystwyth, to form the nucleus of a fund to be formed and administered in accordance with a scheme to be prepared by the said University College, and approved by my trustees, to enable professors, after a certain number of years of service—say, not less than ten—to be released from the professorial duties for a period of about a year, and, at any rate, not less than six months on full salary, a substitute being paid out of the income of the fund, the purpose of this release from college duties being to enable the professor to refresh his mind by travel or research or visits to other universities, and so gain fresh stimulus and equipment for his work."

IT has been announced that the ordinance for the institution of degrees in veterinary science promoted by the University of Edinburgh has been passed by the Privy Council, and has received his Majesty's sanction. The ordinance will come into operation at the beginning of the next summer session, and by it the University is empowered to confer the degrees of Bachelor of Science and Doctor of Science in veterinary science. The Edinburgh veterinary student will now be in a position to obtain an academic distinction in addition to the diploma of membership of the Royal College of Veterinary Surgeons. The present time marks a distinct epoch in the history of veterinary science in Scotland. The Royal (Dick) Veterinary College—the original Scottish veterinary school—is about to enter upon a fresh era, inasmuch as it has been decided to erect new and up-to-date buildings on a scale which will do credit to the important educational centre in which it is located. At the same time, the students of the college are being afforded the means of entering the ranks of university graduates. These developments cannot fail to exert an important effect upon veterinary teaching in Edinburgh and upon the veterinary profession in Scotland.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 18. — Sir Archibald Geikie, K.C.B., president, followed by Sir A. B. Kempe, vice-president, in the chair.—Dr. J. S. **Haldane**, C. Gordon **Douglas**, Dr. Y. **Henderson**, and Dr. E. C. **Schneider**: The physiological effects of low atmospheric pressures, as observed on Pike's Peak, Colorado. The

following is a short preliminary account of a series of observations made in the summer of 1911 on the summit of Pike's Peak, Colorado. Pike's Peak is 14,107 feet above sea-level, the barometric pressure on the summit being about 18 inches (457 mm.). There is an excellent stone house close to the summit, in which the authors were accommodated during their stay of five weeks. The main object of the expedition was to discover to what extent, and by what means, adaptation takes place to low barometric pressure, and consequent deficiency in the partial pressure of oxygen in the air. The authors' chief conclusions are as follows:—(1) After two or three days on the summit of Pike's Peak very distinct signs of acclimatisation began to appear. (2) Before acclimatisation occurred, blueness of the lips and face, nausea, intestinal disturbance, headache, fainting in some persons, and periodic breathing were observed, besides great hyperpnœa on exertion or holding the breath for a few seconds. (3) All these symptoms are referable, directly or indirectly, to want of oxygen produced by the diminished partial pressure of oxygen in the air. The authors did not observe, either in themselves or in the large number of persons who ascended the peak, any symptoms (apart from the effects of the bright light) not referable to the same cause. (4) After acclimatisation had occurred these symptoms disappeared, with the exception that hyperpnœa on exertion or on holding the breath for a few seconds was still much greater than usual. Periodic breathing was still observed occasionally, and blueness of the lips and face was present after continuous and powerful exertion, such as walking up hill. (5) The respiratory exchange during rest remained about normal in the one subject on whom exact experiments were made, and the respiratory exchange during work did not appear to be markedly increased. (6) After acclimatisation the alveolar carbon dioxide pressure was diminished from about 40 mm. to about 27 mm. during rest or moderate exertion, which corresponded to an increase of about 50 per cent. in the ventilation of the lung alveoli. During severe exertion the alveolar carbon dioxide pressure was about half what it normally is during similar exertion, which corresponded to an increase of about 100 per cent. in the hyperpnœa; and owing to a temporary alteration in the respiratory quotient the breathing was still further increased, so that it was for a time increased to thrice what it would have been at sea-level with the same oxygen consumption. (7) The change in the level of alveolar carbon dioxide pressure occurred gradually after going up, and disappeared gradually on coming down, the change taking a number of days to reach completion. (8) The percentage of hæmoglobin in the blood increased for several weeks on the summit of Pike's Peak, and varied in different acclimatised persons from 115 to 154 per cent. on the scale of the Gowers-Haldane hæmoglobinometer, corresponding to an oxygen capacity of from 21 to 28·5 c.c. of oxygen per 100 c.c. of blood. The number of red corpuscles per cubic mm. of blood increased parallel with the hæmoglobin, and the percentage volume of red corpuscles, as determined by the hæmatocrit, also increased in proportion to the percentage of hæmoglobin. (9) A large increase in the total amount of hæmoglobin (determined by the carbon monoxide method) in the body occurred during the first three weeks, and along with this increase there was found, except in the first week, a slight increase in blood volume, as well as the increase, already referred to, in the percentage of hæmoglobin. (10) On coming down from Pike's Peak the hæmoglobin percentage diminished much more rapidly than the total hæmoglobin, so that the blood volume was still further increased at first. It required about four weeks for the excess of hæmoglobin and blood volume to disappear, though the hæmoglobin percentage fell to normal much earlier. (11) So far as the authors could ascertain, there was very little change in the rate of circulation on Pike's Peak after acclimatisation. Pulse and blood pressure were but little affected. In most cases, however, there was a slight increase in the pulse-rate. (12) After acclimatisation the oxygen pressure in the arterial blood (measured by the carbon monoxide method) rose during rest to about 35 mm. of mercury, or 66 per cent. above the alveolar oxygen pressure, and remained at a level of only about 12 mm. below the normal oxygen pressure at sea-level. Immediately after ascending the peak, and before acclimatisation had occurred, the arterial oxygen pressure was found to be about 45 mm. below normal, and only slightly above the alveolar oxygen pressure. This change appears to be due to a progressive increase in the activity of the alveolar epithelium in secreting oxygen inwards. On raising the alveolar oxygen pressure to normal, the difference between alveolar and arterial oxygen pressure diminished rapidly. (13) Acclimatisation to high altitudes is due mainly to the increased secretory activity of the alveolar epithelium, but partly also to the increased lung ventilation, and to a lesser extent to the increased hæmoglobin percentage in the blood. The acclimatisation takes some days to develop. During rapid ascents in balloons or aëroplanes it would not have time to develop, and this explains the contrast between the experience of balloonists, &c., and that of mountaineers who ascend gradually.—J. **Barcroft**: The effect of altitude upon the dissociation curve of the blood. The affinity of hæmoglobin for oxygen depends, among other things, upon the hydrogen ion concentration of the blood. After removing the CO_2 from blood, a scale was made out for the blood of each person plotting the percentage of oxyhæmoglobin at a standard oxygen pressure vertically, and the amount of acid added to the blood horizontally. Thus, by estimating the percentage of oxygen in the hæmoglobin of blood at high altitudes, an estimate can be made of the acid which has been contributed to it by the organism. It thus appeared that at each altitude the alkalinity of the blood decreased (apart from CO_2). This was so in the resting individual, but much more markedly so during exercise. The dissociation curve of blood exposed to the CO_2 pressure of the alveolar air confirmed the result that during rest the dissociation curve remains constant. During activity the affinity of the blood for oxygen decreases, and the hæmoglobin is able to unite with less oxygen in the lung, and to do so at a lower rate. On the other hand, the rate of dissociation in the tissues increases. The acid which accumulates in the blood is not lactic acid entirely, and during rest only to a slight extent. The persons whose blood was most alkaline (apart from CO_2) were most prone to sickness.—R. **Kirkpatrick**: Note on *Astrosclera willeyana*, Lister. *Astrosclera willeyana*, Lister, is a small columnar, or mushroom-shaped, organism, somewhat resembling a coral in appearance. It has been described by various zoologists respectively as a calcareous sponge, a siliceous sponge, and a coral. Mr. Kirkpatrick, who dredged numerous specimens from a depth of 50 to 100 fathoms off Christmas Island, Indian Ocean, has found that the organism is a siliceous sponge with a supplementary skeleton of aragonite, and that it owes its unique character (viz. that of forming a supplementary skeleton of aragonite) to its association with a degenerate *Floridean alga* (red seaweed). Certain of the sponge cells envelop the spores of the alga, and secrete around them concentric layers of aragonite. The little spherules so formed are in several respects comparable with the cyst pearls of pearl oysters and mussels. The spherules are at first loose and separate, but later become welded together so as to form a firm coral-like skeleton. The encysted algal spores may be killed and wholly calcified, or they may retain their vitality and germinate, so as to form branching thread-like filaments, which bore their way through the solid calcareous walls. The algal plants in the soft tissues of the sponge are of microscopic dimensions.—Dr. H. B. **Fantham**: *Herpetomonas pediculi*, nov. spec., parasitic in the alimentary tract of *Pediculus vestimenti*, the human body-louse. *Herpetomonas pediculi* is a parasitic flagellate protozoon. It has been investigated especially in body-lice reared and fed on the author's own blood. It also occurs in "wild" lice, but only some 8 per cent. are infected, and then slightly. The life-cycle of the parasite comprises pre-flagellate, flagellate, and post-flagellate stages, which gradually merge into each other. These forms of the parasite occur broadly in the fore-, mid-, and hind-gut respectively of adult lice, while pre-flagellate stages also occur in the digestive tract of larval *pediculi*. The pre-flagellate stage resembles the Leishman-Donovan body. The length of the flagellate body varies from 11 μ to 26 μ, while the single free flagellum is usually about as long as the body. Oval, encysted post-flagellate stages may be recovered from the fæces of infected lice. Striated thick-walled cysts occur very rarely. The mode of infec-

tion is casual, cysts being swallowed accidentally by lice. There is no hereditary infection. *H. pediculi* is important in at least two respects:—(1) it occurs in human body-lice, which themselves may act as carriers of disease in certain circumstances in some parts of the world; also (2) it has been asserted that parasites belonging to the genera Herpetomonas and Crithidia, occurring in blood-sucking insects, are stages in the life-cycles of trypanosomes of vertebrates. Although many lice, infected with *H. pediculi*, had been bred on the author's body, fed only on his blood throughout their lives, and kept confined, yet no trypanosome has been found in his blood, whether examined by smear, thick film, culture, or by sub-inoculation into white rats, the experiments having extended over a period of nearly three years. Also, rats inoculated with *H. pediculi* have not developed trypanosomes. *H. pediculi* is a harmless parasite of the digestive tract of *Pediculus vestimenti*, and has no connection with any vertebrate trypanosome. The possible occurrence of such a natural Herpetomonas in lice must be remembered when experimenting with *pediculi* as possible transmitters of Leishmania.—Captain A. D. **Fraser** and Dr. H. L. **Duke**: An antelope trypanosome. Ten days after blood of a bushbuck, which was shot on the shores of the Victoria Nyanza, had been injected into a healthy goat, trypanosomes appeared in the goat's blood. The same species of trypanosome was present in blood smears made from another bushbuck and a sikitunga, which were shot in the same neighbourhood. The small characteristic trypanosome corresponds morphologically to the one which was discovered in cattle in Uganda, and was named *Trypanosoma uniforme* by the Royal Society Sleeping Sickness Commission, 1908–10. This is shown by curves representing the distribution, by percentages, in respect to length of the antelope trypanosome and *T. uniforme*. Cattle, goats, sheep, and bushbuck were infected. Monkeys, pigs, dogs, cats, guinea-pigs, and white rats proved to be refractory. It is concluded that the trypanosome found in the antelope was *T. uniforme*. Experimentally it was shown that laboratory-bred *Glossina palpalis* were capable of transmitting this species of trypanosome from infected to healthy animals. Of six experiments, four were successful. The flies became infective in from twenty-seven to thirty-seven days, and the infection in the fly was always limited to the proboscis. In order to ascertain if *G. palpalis* caught on the Lake-shore, near where the infected antelope had been shot, were naturally infected, flies were collected there and brought to Mpumu, where they were fed on a healthy goat. After 1020 flies had been put on the goat it became infected with *Trypanosoma uniforme*. Some days afterwards *T. vivax*, with which wild flies had previously been shown to be naturally infected, also appeared in the goat's blood. The conclusions are:—(1) this trypanosome, which is of fairly frequent occurrence among Lake-shore antelope, is *T. uniforme*; (2) the available evidence points to *Glossina palpalis* as being the carrier of this species of trypanosome; (3) *G. palpalis* caught on the Lake-shore are naturally infected with *Trypanosoma uniforme*.

PARIS.

Academy of Sciences, January 8th.—M. Lippmann in the chair.—Paul **Sabatier** and A. **Mailhe**: The catalytic decomposition of formic esters. The authors have previously shown that formic acid suffers catalytic decomposition in two different ways, some catalytic agents, such as titanium dioxide, producing carbon monoxide and water, others, such as finely divided metals and zinc oxide, giving rise to carbon dioxide and hydrogen. Catalysis by the oxides of thorium, manganese, &c., takes place in both ways. The study has been extended to the action of these various catalytic agents on the formic esters, and the predominant reaction is a decomposition of the ester into alcohol and carbon monoxide.—G. **Fayet**: A new comet of short period. Observations on a very faint comet, of about seven years' period, discovered by M. Schaumasse.—M. **Tzitzéica**: Isothermal surfaces.—Paul **Lévy**: The integro-differential equations of M. Hadamard.—P. **Helbronner**: Survey of the higher regions of the French Alps.—Marcel **Oswald**: A simple relation between the coefficient of expansion of liquids and the temperature. If a be the coefficient of expansion at T° absolute, T_c the critical temperature absolute, then the expression $a = \frac{1}{2T_c - T}$ holds good. Using the general formula $a = \frac{1}{\lambda T_c - T}$, the values of λ obtained with various liquids approximate closely to 2.—C. **Matignon** and M. **Lassieur**: Actions of nitrogen and oxygen on magnesium. Oxygen begins to act on magnesium at 600° C., and nitrogen at about 670° C., the former acting much the more rapidly. The addition of mercury to form an amalgam does not facilitate these reactions.—L. C. **Maillard**: Action of amino-acids on the sugars. Amino-acids act rapidly at 100° C., slowly at 37° C., with various sugars, producing brown substances, with elimination of carbon dioxide and water. The carbon dioxide is split off from the amino-acid. The action is general, having been obtained with glycocine, sarcosine, alanine, tyrosine, glutamic acid, &c.; of these, alanine acts the most readily.—Marin **Molliard**: Comparison of the phenomena of oxidation in galls and in the homologous normal organs. The respiratory quotients for normal leaves of the elm, and for the galls produced by *Tetraneura Ulmi*, are practically the same in darkness; but in light, in an atmosphere containing 8 per cent. of carbon dioxide, for the same volume of this gas absorbed, much less oxygen is evolved by the galls than by the sound leaves.—J. **Winter**: Remarks on the gastric acidity. There is no uniform type of gastric juice, its composition depending on the food taken, the psychic state, &c. There is no direct connection between the production of gastric juice and that of its acid constituents.—H. **Labbé** and L. **Violle**: Elimination of aminoid nitrogen in depancreatised dogs. In depancreatised dogs the ratio of the urinary amino-acid nitrogen to the total nitrogen of the urine is about four times as great as for normal animals.—P. **Magitot**: The possibility of preserving the human cornea in a living state after removal from the body. A human eye, removed in a case of glaucoma, was kept for eight days in hæmolysed human serum, the cornea, previously opalescent, gradually regaining its transparency. Part of this cornea was then grafted into another patient's cornea which had become entirely opaque owing to an accident. The transplanted cornea has retained its transparency after seven months, and the vision is one-tenth normal.—Robert **Lévy**: Relation of arachnolysin to the female genital organs of spiders.—Maurice **Arthus**: Intoxication by venoms and by proteids. The effects of snake poisons on rabbits closely resemble those of anaphylaxis, therefore a rabbit sensitised by injection of proteid material should be rendered more sensitive to snake venoms, and *vice versâ*. This is found to be the case. The venom of the cobra has two distinct actions, one an effect common to snake poisons, the other a curare-like action confined to the venoms of a restricted number of snakes.—L. G. **Seurat**: The life-cycle of the Spiroptera of the dog.—F. **Picard**: The biology of the potato-moth (*Phtorimaea opercullela*) and its occurrence in France. This moth, which inflicts great damage on the potato crop in the United States, Australia, and other parts of the globe, has lately appeared in various districts in France, but so far its distribution there is not wide. Disinfection with carbon bisulphide appears to be the only remedy.—A. **Quidor**: Torsion of the Lernæidæ, and their affinities to Sphyrion and Hepatophylus.—Louis **Gentil**: Geological observations on the route of General Moinier's column between Fez and the Atlantic Coast.—E. A. **Martel**: The cañon of the Rhone.—Alfred **Angot**: Value of the magnetic elements at the Observatory of Val-Joyeux to January 1, 1912.—Alfred **Angot**: Mean value of the cloudiness at the time of the forthcoming total eclipse of the sun. The chances for and against fine weather along the central line in France on April 17 have been arrived at from consideration of the weather, at Paris and Nantes, for the period April 15 to 19 during the twenty years 1891–1910. The unfavourable cases exceed the favourable by nearly 2 to 1.

January 15.—M. Lippmann in the chair.—B. **Baillaud**: The catalogue of stars published by M. Cosserat, director of the Observatory of Toulouse. Remarks on vol. viii. of the "Annales de l'Observatoire de Toulouse."—Émile **Picard**: A general theorem relating to

uniform functions of one variable connected by an algebraical relation.—E. **Vallier**: The present position of the ballistic problem. A *résumé* of the formulæ that have been proposed to connect the air resistance with the velocity of a projectile.—Auguste **Righi**: Sparks in rarefied air and under the action of a magnetic field. The effect produced is illustrated by a photographic reproduction; an illustration of a special form of vacuum tube is also given, by means of which the mechanical effects of the spark in gases under reduced pressure have been studied.—The secretary announced the death of Jacob Amsler, correspondant for the section of mechanics.—J. **Hadamard**: A question relating to viscous liquids. An acknowledgment of priority to a paper by M. Rybczynski.—Louis **Roy**: The general equations of flexible membranes.—M. **de Broglie**: The observation of the Brownian motion in gases at low pressures. Working with fumes of phosphorus in air at about 1 mm. pressure, the independence of the Brownian motion and the pressure has been approximately verified for pressures between wide limits, but starting from a certain pressure (some millimetres of mercury) the agitation tends to increase.—C. **Leenhardt** and A. **Boutaric**: Cryoscopy in sodium thiosulphate crystallised with five molecules of water. A direct determination of the latent heat of fusion calorimetrically gave $L=47 \cdot 9$ at the temperature 48·5°, and using this value in the van 't Hoff formula, the molecular lowering found is $K=42 \cdot 8$. The direct determination of K with urea as the solute gave $K=42 \cdot 6$. It is important that the solvent should contain water of crystallisation corresponding exactly with the formula $Na_2S_2O_3.5H_2O$, and details of the method of working are given.—Eugène **Wourtzel**: A new determination of the atomic weight of nitrogen. The method is based on the determination of the weight of oxygen required to convert a known weight of nitric oxide into the peroxide N_2O_4. Five experiments gave $N=14{,}007$ ($O=16$), the extreme values being 14,005 and 14,008.—A. **Besson**: The preparation of magnesium silicide and its decomposition by acids. A study of the reaction between magnesium powder and finely divided quartz, and of the conditions giving a maximum yield of magnesium silicide. Hydrochloric acid was found to be the best acid for attacking the silicide, the maximum yield of hydrogen silicide obtainable being from 6 per cent. to 7 per cent.—L. **Hugonenq** and A. **Morel**: The combinations of chromium hydroxide with the amino-acids derived from the albumens.—A. **Guyot** and A. **Kovache**: The action of formic acid upon the triarylcarbinols. Triphenylcarbinol $(C_6H_5)_3.C(OH)$, heating with 20 times its weight of anhydrous formic acid, is quantitatively reduced to the hydrocarbon triphenylmethane, and the reaction is general for triarylcarbinols.—A. **Tison**: The dichotomic nervation in the Conifers. Dichotomy is shown to be the normal mode of ramification in certain appendices of Conifers.—G. **Arnaud** and Ed. **Foëx**: The form of Oïdium of the oak in France.—A. **Marie** and Léon **MacAuliffe**: The morphological characters of 61 French murderers and suicides.—A. **Magnan**: Food and the length of the intestine in mammals. Results of the dissection of 280 mammals show that the nature of the food is an important factor in the evolution of the alimentary canal.—M. **Bizot**: The brachio-antibrachial in the Cheiroptera.—Mlle. E. **Peyrega** and F. **Vlès**: An oxyhæmoglobin band in the ultraviolet spectrum of blood. This band, in position near Cd 12, was first noted by Soret in 1883, but its existence has since been denied by many investigators. The authors' investigations confirm those of Soret, and they consider that the negative results obtained subsequently were due to too rapid variations of the concentration.—E. **Vasticar**: The structure of the internal pillars of Corti's organ.—A. **Trillat**: The influence of the gases evolved by putrefying organic substances on the growth of bacteria.—Paul **Vuillemin**: A human parasitic fungus, *Glenospora graphii*.—P. **Chaussé**: A new distinctive character of the human and bovine tubercle bacillus. The domestic animals, dog and cat, contract tuberculosis much more easily from the bovine tubercle bacillus than from that of human origin.—J. **Bridré** and A. **Boquet**: Vaccination of sheep against scab by means of a specially prepared virus. The process of preparing the modified virus is described in detail, and from the results of experiments on 300 sheep the method would appear to be of general application. It has several advantages over the method in current use, the main one being that the closed local lesion is not contagious.—F. **Kerforne**: The nature and origin of the iron minerals of the forest of Lorges (Côtes-du-Nord).—Émile **Haug** and Léon **Bertrand**: The geological structure in the north of the department of Var.—J. **Vallot**: The measurement of the subterranean excavation produced by the spring of Fon Tréboula.—M. **Thoulet**: A bathy-lithological map of the sea floor on the coasts of the Gulf of Lyons.

NEW SOUTH WALES.

Linnean Society, November 29, 1911.—Mr. W. W. Froggatt, president, in the chair.—P. **Cameron**: A collection of parasitic Hymenoptera (chiefly bred) made by Mr. W. W. Froggatt in New South Wales, with descriptions of new genera and species. Part ii. Five genera and nineteen species of the family Chalcididæ are described as new. The type-specimens of three species were bred from the codlin-moth.—R. E. **Turner**: A revision of the Australian species of the genus Cerceris (Hymenoptera). Eighteen species, including one described as new, are treated of. The types of all the species, except the common *C. australis*, Sauss., have been consulted. The dry conditions prevalent over a large part of Australia are eminently suitable for the members of the genus. Nevertheless, it may prove not to be so well represented as in North Africa and India, for the section of the genus, characterised by a raised plate at the base of the second ventral segment, seems to be entirely absent from Australia.—Dr. R. **Greig-Smith**: Contributions to a knowledge of soil-fertility. No. iv. The agricere and bacterio-toxins of soil. Soils which have been heated to 65°–75° in order to kill off the phagocytic protozoa of Russell and Hutchinson give a greatly increased bacterial growth after treatment with the volatile disinfectants or fat-solvents. This effect is obtained with the soil-bacteria and with added test-bacteria. The treatment with disinfectants, therefore, does something more than destroy the protozoa. One is justified in ascribing the effect to the translation of the agricere by the behaviour of the various layers of the soil, following the treatment with ether or chloroform. The top layers, which contain most translated agricere, give lessened bacterial growths, and, conversely, the lowest layers produce greater numbers of bacteria than the intermediate soil. The action of the agricere cannot be so clearly shown in soils heated at higher temperatures, on account of the disturbing influences of the natural toxins and the heat-toxins of Pickering. The volatile disinfectants have no action upon the toxins of the soil, either in destroying or translating them. The enhanced bacterial growth after chloroform treatment could not be credited to traces of disinfectant remaining in the soil. It was noted that an abnormally toxic soil became normal after heavy rains, and experimental work showed that the toxins were washed from the upper into the lower layers.—D. **McAlpine**: The fibro-vascular system of the pear (pome). After maceration in water for five days, the elaborate fibro-vascular system may be satisfactorily displayed. It has the same general plan as that of the apple, described in detail in a paper read at the last meeting.—A. B. **Walkom**: Note on a new species of Favosites from the Yass District, N.S.W. The fossil coral described occurs in the Silurian beds of Derrengullen Creek, near Yass, together with *F. gothlandica*, Lam., and *F. basaltica*, Goldfuss, var. *salebrosa*. It is more nearly allied to the former, but has the corallite tubes generally larger, the tabulæ more closely spaced, the septa more regularly arranged and shorter, and the mural pores usually in three vertical rows.

BOOKS RECEIVED.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe, C.B., F.R.S., assisted by eminent contributors. Revised and enlarged edition. Vol. i. Pp. viii+758. (London: Longmans and Co.) 45*s*. net.

Papers and Proceedings. Fifth Annual Meeting, American Sociological Society, held at St. Louis, Mo., December 27–30, 1910. Vol. v. Pp. vi+207. (Chicago: University of Chicago Press; Cambridge University Press.)

Scientific Features of Modern Medicine. By Prof. F. S.

Lee. Pp. vii+183. (New York: Columbia University Press; London: H. Frowde.) 6s. 6d. net.

Sea Fisheries: their Treasures and Toilers. By Prof. M. A. Hérubel. Translated by B. Miall. Pp. 366. (London: T. Fisher Unwin.) 10s. 6d. net.

Maryland Geological Survey. Lower Cretaceous. Pp. 622. (Baltimore: Johns Hopkins Press.)

Forest Physiography: Physiography of the United States and Principles of Soils in relation to Forestry. By Dr. I. Bowman. Pp. xxii+759. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 21s. net.

Handbuch der Pharmakognosie. By A. Tschirch. Lieferung 22–28. (Leipzig: C. H. Tauchnitz.) 2 marks each.

Physico-chemical Calculations. By Dr. J. Knox. Pp. viii+188. (London: Methuen and Co., Ltd.) 2s. 6d.

Technical Arithmetic and Geometry. By C. T. Millis. Second edition. Pp. xvi+299. (London: Methuen and Co., Ltd.) 3s. 6d.

A First Year Physical Chemistry. By Dr. T. P. Hilditch. Pp. xx+176. (London: Methuen and Co., Ltd.) 2s.

J. H. Van't Hoffs Amsterdamer Periode, 1877–1895. By Drs. W. P. Jorissen and L. Th. Reicher. Pp. 106. (Helder: C. de Boer, jun.)

A Junior Course of Practical Zoology. By the late Prof. A. Milnes Marshall, F.R.S., and Dr. C. H. Hurst. Seventh edition. Revised by Prof. F. W. Gamble, F.R.S. Pp. xxxvi+515. (London: Smith, Elder and Co.) 10s. 6d.

The Great Star Map. By Prof. H. H. Turner, F.R.S. Pp. vi+159. (London: J. Murray.) 2s. 6d. net.

Heredity and Society. By W. C. D. Whetham, F.R.S., and C. D. Whetham. Pp. viii+190. (London: Longmans and Co.) 6s. net.

The Principle of Individuality and Value (the Gifford Lectures for 1911). By Dr. B. Bosanquet. Pp. xxxvii+409. (London: Macmillan and Co., Ltd.) 10s. net.

Fourth Report of the Wellcome Tropical Research Laboratories at the Gordon Memorial College, Khartoum. Vol. B.—General Science. By Dr. A. Balfour and others. Pp. 333. (London: Baillière, Tindall and Cox.) 18s. net.

Cocoa and Chocolate: their Chemistry and Manufacture. By R. Whymper. Pp. xi+327. (London: J. and A. Churchill.) 15s. net.

American Permian Vertebrates. By Prof. S. W. Williston. Pp. 145+plates. (University of Chicago Press: Cambridge University Press.) 10s. each.

Jelineks Psychrometer-Tafeln. Anhang: Hygrometer-Tafeln. By J. M. Pernter. Sechste, erweiterte Auflage. Pp. xii+128. (Leipzig: W. Engelmann.) 7 marks.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—Determination of the Co-efficient of Interdiffusion of Gases and the Velocity of Ions under an Electric Force, in terms of Mean Free Paths: Prof. J. S. Townsend, F.R.S.—Note on the Scattering of α-Particles: Dr. H. Geiger.—The Effect of Temperature upon Radioactive Disintegration: A. S. Russell.—On the Relation between Current, Voltage, Pressure, and the Length of the Dark Space in Different Gases: F. W. Aston and H. E. Watson.—On the Viscosities of Gaseous Chlorine and Bromine: Dr. A. O. Rankine.—The Testing of Plane Surfaces: Dr. P. E. Shaw.—Antelope Infected with *Trypanosoma gambiense*: Captain A. D. Fraser, R.A.M.C., and Dr. H. L. Duke.

ROYAL INSTITUTION, at 3.—The New Astronomy: Prof. A. W. Bickerton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Heat Paths in Electrical Machinery: Miles Walker and H. D. Symons.

FRIDAY, JANUARY 26.

ROYAL INSTITUTION, at 9.—The Pressure of a Blow: Prof. B. Hopkinson, F.R.S.

PHYSICAL SOCIETY, at 5.—Exhibition of a Direct-reading Instrument for Submarine Cable and other Calculations: R. Appleyard.—On the Vibration Galvanometer and its Application to Inductance Bridges: S. Butterworth.—Note on a Negative Result connected with Radio-activity: J. H. Vincent and A. Bursill.—On Sealing-metals: Dr. P. E. Shaw.—Krypton and the Auroral Spectrum: T. W. Page.

SATURDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—The Banyoro: A Pastoral People of Uganda: (2) Birth and Death Customs; Rev. J. Roscoe.

ESSEX FIELD CLUB (at the Essex Museum, Stratford, Essex), at 6.—Weather Observations in connection with the Work of the Essex Field Club: William Marriott.

MONDAY, JANUARY 29.

ROYAL SOCIETY OF ARTS, at 8.—Ocean Waves, Sea-beaches, and Sandbanks: Dr. Vaughan Cornish.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration in the Canadian Rockies: Prof. J. Norman Collie, F.R.S.

INSTITUTE OF ACTUARIES, at 5.—The Investment of Life Assurance Funds: G. E. May.

TUESDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—Irrigation in South Africa: W. A. Legg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Central Heating- and Power-plant of McGill University, Montreal: R. J. Durley.

WEDNESDAY, JANUARY 31.

ROYAL SOCIETY OF ARTS, at 8.—Recent Progress in Radio-telegraphy: Prof. G. W. Osborn Howe.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Bacterial Production of Acetylmethylcarbinol and Butylene Glycol from Various Substances: Dr. A. Harden, F.R.S., and Miss D. Norris.—On the Distribution of the Nerves of the Dental Pulp: J. H. Mummery.—A Method for Isolating and Cultivating the Mycobacterium Pseudo Tuberculosis enteritidis bovis Jöhne, and some Experiments on the Preparation of a Diagnostic Vaccine for Pseudo Tuberculosis enteritis of bovines: F. W. Twort and G. L. Y. Ingram.—On the Fossil Flora of the Forest of Dean Coalfield (Gloucestershire), and the Relationship of the Coalfields of the West of England and South Wales: E. A. N. Arber.—The Chemical Action of Bacillus Cloacæ (Jordan) on Glucose and Mannitol: J. Thompson.—Simultaneous Colour Contrast: Dr. F. W. Edridge-Green.

LINNEAN SOCIETY, at 8.—Fourmis des Seychelles reçues de M. Hugh Scott: Prof. A. Forel.—Tipulidæ from the Indian Ocean: F. W. Edwards.—Sciaridæ, mit einem Anhang von Dr. J. J. Kieffer (Beschreibung neuer Sciariden von den Seychellen Inseln): Dr. Günther Enderlein.—Ichneumonidæ from the Indian Ocean: C. Morley.—New Fishes from Aldabra and Assumption, collected by Mr. J. C. F. Fryer: C. Tate Regan.

ROYAL INSTITUTION, at 3.—The Phenomena of Splashes: Prof. A. M. Worthington, C.B., F.R.S.

FRIDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 9.—Vital Effects of Radium and other Rays: Sir J. M. Davidson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steam-turbines: Some Practical Applications of Theory: Captain H. Riall Sankey, R.E.

CONTENTS.

THURSDAY, FEBRUARY 1, 1912.

THE STUDY OF CRYSTALS.

(1) *Crystallography and Practical Crystal Measurement.* By Dr. A. E. H. Tutton, F.R.S. Pp. xiv+946, with 3 plates and 720 figures in the text. (London: Macmillan and Co., Ltd., 1911.) Price 30*s.* net.

(2) *Crystals.* By Dr. A. E. H. Tutton, F.R.S. Pp. x+301, with 24 plates and 120 figures in the text. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1911.) Price 5*s.* (The International Scientific Series.)

THE rapid advances which have been made in recent years in our knowledge of crystals, and the increasing number of points at which crystallography comes into contact both with chemistry and physics, render it more than ever desirable that students of these sciences should acquire a sound knowledge of the nature and properties of crystals and an acquaintance with the methods of crystallographic research. In illustration of this it is only necessary to refer on one hand to the work of Pope and Barlow on the relation between valency and crystalline structure, and on the other to that of Lehmann, Vorländer, and others on the remarkable group of bodies forming the so-called "liquid crystals."

Although numerous excellent treatises on crystallography have been published in recent years in Germany and France, in England the number of works devoted to this subject has been very limited, and, until the recent appearance in America of a translation of the optical section of Prof. Groth's well-known book, the only information available on the physical side in English has been that contained in the introductory portions of text-books of mineralogy. There was thus ample room for a new book, and Dr. Tutton's volume on "Crystallography and Practical Crystal Measurement" (1) will be welcomed by all workers in the subject. Although in some respects incomplete, its very full treatment of what are, from the practical point of view, the most important branches, viz. crystal measurement and optics, render it a valuable and important addition to the literature.

The book is essentially a practical one, and is chiefly concerned with the methods of determining the form of crystals and of measuring their various physical constants; but attention is also given to the underlying matters of theory. It is divided into two parts of nearly equal length, dealing respectively with the morphology and the physical properties of crystals.

The practical and theoretical portions of the subject are treated side by side, in successive chapters. Thus, in part i., after a short introduction on the nature of crystals, a description of the method of preparing suitable crystals for measurement is followed by a chapter on the goniometer, and this is at once illustrated by an account of the actual measurement of a crystal of potassium sulphate. The succeeding chapters treat of axes and the law of rationality, zones and the stereographic projection, and the formulæ required in calculation; and the measurements of the crystal previously made are then worked out in detail. An account is next given of the theories of crystals as homogeneous structures, and of crystal symmetry and its thirty-two types. Chapters xi. to xxiv. are devoted to an account of the crystal systems and the various forms possible in each of the thirty-two classes, the discussion of each system being followed by a full account of the measurement and calculation of one or two crystals belonging to it.

Among subjects dealt with in later chapters may be mentioned goniometry at higher temperatures and the change in the angles of crystals on heating, goniometers with two and three circles and the gnomonic projection, the density, volume, and structure of crystals and the calculation of their molecular "distance ratios." Part i. ends with a useful account of Fedorov's theory of cubic and hypohexagonal types, and a short reference to the theory of Pope and Barlow on valency-volumes.

The description of Fedorov's theory and his method of arriving at the correct mode of setting up a crystal in accordance with its structure, is especially noteworthy as containing the first account which has appeared in English of his method of "crystallo-chemical analysis," by means of which it will be possible to identify, after measurement of its crystals and reference to an index, any chemical substance of which the crystalline data have been incorporated in the index. The method is not yet available for general use, but in the hands of Prof. Fedorov it has already proved very successful under numerous tests, and seems likely in the future to prove of great service to the chemist.

In the chapters on crystal axes, zones, and indices, as well as in those on crystalline symmetry, the stereographic projection, &c., proofs have perhaps wisely been omitted; but some explanation of the meaning of the numbers forming a zone-symbol might well have been included.

The second, or physical part of the book (pp. 547–933) is devoted almost entirely to the discussion of the optical properties of crystals and the methods of determining them. The methods of measuring the expansion of crystals by heat and their elastic properties by means of the author's interference-apparatus, are also described, and the last chapter contains a short account of the hardness of crystals, and of liquid crystals, and the use of the "crystallisation microscope." No reference is made, however, to other physical properties, such as pyro-, piezo- and thermo-electricity, and thermal and electric conductivity.

The first eight chapters in this part (pp. 545–680) are occupied with a discussion of the nature of light and the mode of its transmission through crystalline media, while the rest of the optical portion (pp. 681–883) is chiefly devoted to a description of the instruments and operations required for the measurement of the various properties expressible by the form and orientation of the optical ellipsoid. This portion includes detailed directions for the cutting and grinding of prisms and plates, the production of monochromatic light of any desired wave-length, the determination

of the directions of light-vibration in crystal plates, and of refractive indices by means of prisms and by total reflection, and the examination and measurement of interference-figures. Pleochroism and the rotation of the plane of polarisation are also discussed, and there are excellent chapters on the crystallographic microscope and its accessories, with an account of Fedorov's universal stage and the methods due to him and to Becke for the location of the optic axes in a crystal section.

The descriptions are very full, and for the most part clear, but some few points have been noted which seem to call for criticism. Thus, for instance, on p. 585, the mode of construction of the optical ellipsoids on three rectangular axes the lengths of which are made (either directly or inversely) proportional to the values of the refractive indices of the crystal for the vibrations taking place along them, is not made clear at the start; and, moreover, the expression, "the refractive index along" a given direction, which frequently occurs, is ambiguous, and does not seem to be anywhere defined. A slip is noticeable on p. 572, where the wave-front in a crystal is stated in the general case to be an ellipsoid.

The methods and apparatus described throughout the book are principally those of which the author has had personal experience in his well-known researches, and the examples are mostly taken from the same source. The treatment is very detailed and almost unnecessarily circumstantial, and in many places there is a good deal of repetition. Thus, for example, in the seven chapters dealing with crystal calculation, though it is no doubt desirable that the advantage of systematic methods of computation should be impressed upon the student, it was perhaps scarcely necessary to insert the actual working (with a diagram) of every spherical triangle and anharmonic ratio computed; whilst in the physical portion of the book a considerable amount of space might have been saved by the omission of much of the large mass of practical detail, particularly that concerning some of the less readily determinable properties, such as elasticity (of which the account occupies eight pages) and thermal expansion (twenty pages), for which the reader may fairly be expected to consult the original memoirs. A reduction in the size and cost of the book would have been advantageous, as rendering it more accessible and at the same time more useful to the student, who may be apt to be somewhat bewildered by the amount of information provided for him.

The numerous illustrations, which have been mostly drawn by the author or specially engraved for the book, are, with a single exception (Fig. 440), all excellent.

(2) The smaller book is based on a lecture delivered by the author at the meeting of the British Association in Winnipeg in 1909, and is intended for the general reader, to whom it aims at presenting an account of some of the more important properties of crystals—geometrical, physical, and chemical—especially in relation to their molecular structure.

The task of conveying to a reader a clear idea of this somewhat extensive subject within the compass of some 300 pages, without assuming some previous acquaintance with crystals, is no easy one, and the difficulty has been increased by the inclusion of numerous practical experimental details, which, however appropriate in a lecture, are of little use in a book of this kind. In the same way, a very large amount of space (twenty pages) has been devoted to the behaviour of plates of quartz and amethyst in polarised light, some of which might probably have been better utilised for an expansion of other parts of the book which have suffered from undue compression, such as the discussions of interference and of molecular "distance-ratios."

Not a few incorrect or misleading statements have been noticed. Thus, for example, the types of symmetry unrepresented among Sohncke's sixty-five point-systems are not those having no plane of symmetry, as indicated on p. 117, but chiefly those showing hemimorphic character. In chapter v., which deals with crystal-axes and the law of rational indices, the meaning of the axial lengths and the manner in which they are determined by means of the intercepts made by a parametral face are not explained early enough, or with sufficient prominence, and the figures of simple pinacoid forms, with inscribed axes, which illustrate the axes of the various systems, are misleading as to this point. Again, on p. 51, the letters *a*, *b*, *c*, are used to denote the three crystal axes, while on p. 57 (without further explanation) they are used for the unit lengths along these axes. Similarly, on p. 57, the "three numbers [*m*, *n*, *r*] expressing the intercepts" appear to denote the actual lengths of the intercepts, while at the bottom of the following page the intercepts are explained as meaning the multiples of the unit lengths, *a*, *b*, *c*. The meaning of the example on p. 58 is far from clear.

There are numerous admirable illustrations of growing crystals, and a good coloured plate of crystals in polarised light, which have been reproduced from the author's own photographs.

It is to be feared that the book will scarcely be intelligible to a general reader without some previous knowledge of the subject, but the student who is already familiar with the elements of crystallography may find much in it that is interesting and suggestive.

H. L. B.

THE GEOGRAPHICAL BASIS OF HISTORY.

A Historical Geography of the British Colonies. Vol. v., Canada. Part iii., Geographical. By J. D. Rogers. Pp. viii+302. Vol. v., part iv., Newfoundland. By J. D. Rogers. Pp. xii+274. (Oxford: The Clarendon Press, 1911.) Price 4*s*. 6*d*. each vol.

TWO more volumes of Sir Charles Lucas's valuable "Historical Geography of the British Colonies" have appeared, in which Canada and Newfoundland are described. The Canadian volume deals with the geography, but the historical aspect is still largely to the fore. No general account of the whole region occurs, in which the principal characteristics of this portion of the North American continent is given, but we are introduced at once to the far north land and

the story of its discovery and exploration. The extreme eastern portion, Nova Scotia, is next treated, and its character and development are traced step by step from its first settlement at the beginning of the seventeenth century until the present time, when its greatest activity centres in the city of Halifax.

Joining this eastern region to central portions of the Dominion is the important province of New Brunswick, which unites the estuary of the St. Lawrence to the Atlantic coast of the Bay of Fundy, and provides Quebec with valuable southern lines of communication without passing into the territory of the United States. To the north of the St. Lawrence lies a barren region between it and Hudson Bay, of which the development has been restricted to Labrador, its eastern coast, and even here resident fishermen and traders, with a thousand or two Eskimos, make up the population. Quebec and Ontario are the two centres about which the history of the middle eastern portion of Canada centres, and in each the story of a steadily advancing utilisation of the land's resources is unfolded. The prairie lands of the middle west are described in their different categories with their natural features and resources, and we see the gradual opening up of the region by the early hunters, who, from Canada and from Hudson Bay in the first instance, were followed later by settlers along the same water routes.

At the present day the grouping of the immigrants of different nationalities along the various railway lines furnishes an interesting case of special geographical distribution of new settlements. The far west, and the north-west, where settlement is still pressing into unopened regions, present a different problem from the last, since the great ranges of the west cover a vast tract of country.

A final essay deals with the civilisation of the far west. Within this moderate compass we have a most complete account of the entrance into this vast region of immigrant peoples from the east, their gradual establishment, and their utilisation of its resources. Their movements largely controlled by the physical features of its surface are well described, and their relation to these features is brought out. A most valuable aid to the student is the ample references which are given throughout, and these show what an immense amount of research Mr. Rogers has devoted to the subject. The geographical descriptions of the various regions contain a considerable amount of geological information, but they might usefully have been carried further in describing the land features, and the part that the different erosive agencies have played and are playing in modelling the surface of the land, for much relating to the human occupation is closely concerned with these. The whole question of relief is but lightly dealt with, and might have advantageously been shown cartographically.

The volume which deals with Newfoundland shows a similar wealth of historical reference and research, presenting with great clearness the gradual development of the colony of fishermen which grew up by itself alongside other fishermen who came yearly to fish, but returned without establishing themselves there. The wealth of the fishing industry has hindered the development of the colony's resources, and kept human activity close to the sea coast and the innumerable creeks which indent it. The long Anglo-French duel is discussed in detail, with ample references to all authorities, and is followed by an instructive chapter on the progress which has taken place by land between 1818 and 1910 in developing the natural resources of the interior. The historical aspect is naturally predominant, but a rather fuller treatment of the land surface and its special character would have been a useful introduction to the history of the colony. H. G. L.

ALBINISM.

A Monograph on Albinism in Man. By Karl Pearson, F.R.S., E. Nettleship, and C. H. Usher. Part i., text, pp. viii+266; atlas, plates A—Z and AA—ZZ. (Department of Applied Mathematics, University College, University of London: Drapers' Company Research Memoirs, Biometric Series, vi.) (London: Dulau and Co., Ltd., 1911.) Price, part i., text and atlas, 35*s.* net.

THIS is the first part of a monograph on albinism which promises to be the most complete presentation, as yet produced, of what is known on this interesting subject. The subject of abnormal pigmentation is important, not only in itself, but also because its elucidation is certain to throw a great deal of light on the still more important question of normal pigmentation.

In the present volume, the authors deal with the history and geographical distribution of albinism, the albinotic skin, leucoderma, and partial albinism; in subsequent volumes they propose to deal with the albinotic eye and the albinotic hair in man and in the lower animals. The atlases accompanying the present and subsequent volumes contain numerous illustrations of albinotic subjects, maps, pedigrees, &c.

Though an enormous amount of labour has been expended in collecting the materials for this volume, we are somewhat surprised, after having read it, to find how little is definitely known about the subject. Taking the question of the geographical distribution of albinism, there appears to be only two countries in Europe, namely, Norway and Italy, in which anything approaching an exact census of the number of albinos in the population has been taken. In the former country the proportion is given as 1 in 10,000, and in the latter 1 in 20,000. It would be very dangerous to rely on these figures as showing a real difference in the susceptiblity of the Nordic and Mediterranean races of Europe.

The chapter on the albinotic skin contains a very complete account of the more recent investigations that have been made to ascertain the nature and origin of the pigment of the skin. We find, however, that the leading authorities on this question are still so much at variance that it is impossible to come to any decisive opinion. We have, on one hand,

Ehrmann's theory, that the material which is converted into melanotic pigment springs from the blood, being, indeed, hæmoglobin which is converted into melanotic pigment by the vital processes of the melanoblasts; and that the pigment is transferred by protoplasmic flow along protoplasmic threads. On the other hand, Meirowsky contends that the epidermal cells themselves can produce pigment, especially under the influence of light, and that the hæmoglobin and migratory melanoblast theory has been completely exploded. Neither microscopic nor biochemical investigation has led to any decisive conclusion on this question. Both sides of the controversy are fairly and fully stated in this part of the monograph.

The remaining chapters deal with leucoderma and partial albinism. Leucoderma is defined as an acquired disease characterised by the presence of progressive white patches with convex borders surrounded by increased pigmentation. It is regarded, by the authors, as the essential pathological pigmentation change wherein is seen albinism in the making, and from this point of view its study is of great importance. Interesting suggestions as to the cause of leucoderma have been made by Beigel, who maintains that it is largely due to modified nerve action, produced by shock, illness, severe chill, or other nerve upset; and by Forel, who offers some evidence that it may be sometimes due to race mixture. Many excellent portraits of leucodermous subjects are contained in the atlas.

In the chapter on partial albinism, the nature and origin of piebaldism is discussed. It is noted that in some cases at least piebaldism is hereditary even as to the position of spots.

Numerous cases are cited and described of leucoderma, piebalds, and spotlings.

This valuable monograph will clear the ground and suggest new lines of research, and the remaining parts will be eagerly awaited.

SUSPENSION BRIDGES.

Ponts Suspendus. By G. Leinekugel le Cocq. Tome i., Ponts Suspendus Flexibles et Semi-Rigides. Pp. xiv+374. Tome ii., Ponts Suspendus Rigides. Pp. 330. (Paris: I. Doin et Fils, 1911.) Price, 2 vols., 10 francs.

THESE two volumes form part of the "Encyclopædia of Science," published under the direction of Dr. Toulouse, and of the subdivision dealing with applied science and engineering, the general editorship of which was entrusted to Prof. D'Ocagne, of l'École des Ponts et Chaussées. The first volume treats of flexible and semi-rigid, and the second of rigid suspension bridges.

In the first two chapters of vol. i. the author gives a brief history of suspension bridges, with short accounts of some of the more famous of them, and some notes on the different systems of construction adopted in practice; the rest of this volume is devoted to analytical investigations of the various problems which have to be solved by the designer of flexible and semi-rigid suspension bridges. M. Leinekugel le Cocq deals first with cables employed in the aërial transport of minerals and other materials across ravines in mountainous districts, and for similar work in connection with the erection of bridges across rivers where the conditions render the construction of staging impossible, as was the case with the bridge across the Zambezi, just below the famous falls, and shows how to determine the length and maximum stresses in such cables when the necessary data are known.

Cables for suspension bridges are then considered; on pp. 88 and 89 the author gives tables showing the relation between dip and span for a number of suspension bridges in Europe and America, and adds some notes as to the methods of constructing such cables, and as to the physical properties of the steel suitable for their manufacture. The deformations produced by temperature changes and by unequal loading are then fully discussed, the formulæ obtained being illustrated by the case of the Williamsburg bridge and others. The effect produced by supporting the cables from two piers of different height, and the design and stresses in the suspension links, are then taken up. The next section of this volume is occupied with a discussion of the methods adopted to increase the rigidity of suspension bridges and thus overcome the serious practical inconveniences which ensue when a suspension bridge is supported only by the principal cables; the treatment of this important problem is very thorough and complete. The first volume concludes with some notes on the construction of the bridge platform, and on the action of the wind upon such bridges.

In an introduction to vol. ii., the author points out that the design of flexible and semi-rigid suspension bridges requires but little knowledge of higher applied mathematics, while, on the other hand, the problems encountered in the design of rigid suspension bridges can only be solved by those who are well equipped on the mathematical side; hence, while examples of the former class of bridge are numerous, the rigid type is only occasionally met with. The first chapter treats of three-hinged, rigid suspension bridges; general principles are first considered, both analytical and graphical solutions are discussed, and full explanations are given as to the method of determining the lengths, stresses, &c., in the bracing and struts between the upper and lower members of such bridges. Illustrative examples selected are the bridge at Pittsburg over the Monongahela, and a bridge near Villefranche on an electric railway line in South France. In the second chapter hinged bridges, with the platform supported by oblique chains, are dealt with, the illustrations of this class being the transporter bridges at Nantes and Marseilles. The concluding chapter is devoted to various important details, such as anchorages and saddles. In the form of an appendix, the author has reprinted the official regulations as to working loads, stresses, &c., in steel bridges, which must be adopted when designing such structures in France and other Continental countries, and also a bibliography of the subject, which should prove of service to engineers engaged in this branch of bridge design.

T. H. B.

THEORY OF ALGEBRAIC NUMBERS.

Introduction à la Théorie des Nombres Algébriques. By Prof. J. Sommer. Edition Française revue et augmentée. Traduit de l'Allemand par Prof. A. Lévy. Pp. x+376. (Paris: A. Hermann et Fils, 1911.) Price 15 francs.

THIS book is a French translation of the work on algebraic numbers by Dr. J. Sommer, professor of the Technical High School of Danzig. It is an elementary exposition designed to be an introduction to the researches of modern German mathematicians, particularly of David Hilbert, whose masterly *résumé* in "Jahrsbericht der deutschen Mathematiker Vereinigung, 1895," is likely to be regarded as a classic. Gauss was the first to enlarge the field of the higher arithmetic by including therein numbers of the form $a+b\sqrt{-1}$. This led to a beautiful theory in the development of which he was followed by Dirichlet, Kummer, Dedekind, and Kronecker, to mention only a few of the most important and successful investigators. The results included extensions and generalisations of many theorems of the higher arithmetic, and in particular of the theorem of quadratic reciprocity. The modern theory of algebraic numbers involves a further extension of the domain of numbers in that every root of an irreducible algebraic equation with rational coefficients is said to be an algebraic number. For a given degree n of such an equation the *corpus* of such numbers comprises every rational function of such roots. When n is 2 we have the quadratic corpus which involves the irrationality $\sqrt{m}$, m being a given integer, not a perfect square, which defines the corpus. This book treats the domain of these numbers with some completeness (pp. 16–183).

The difficult subject of "ideal numbers," an invention of Kummer, is introduced lucidly, and subsequently well handled. The reader is then brought to the chapter entitled, "Applications of the Theory of the Quadratic Corpus," and will there find the most interesting part of the book. One of these applications is to the world-famous "last theorem" of Fermat, which asserts the insolubility in integers of the equation

$$x^n+y^n=z^n,$$

when n is an integer superior to 2. The proofs when n is 3, 5, 11, or 14 resulted from the attacks of Euler, Legendre, and Dirichlet, while Kummer, utilising his ideal numbers, established the theorem for all prime values of n less than 100. The theorem as asserted by Fermat still awaits proof. The next application is to the theory of quadratic forms in the higher arithmetic of integers. The theory of the extended domain is shown to involve remarkable extensions of theory in the restricted domains which were initially handled with so much success by Gauss. The remaining chapters are on the "Cubic Corpus," and the "Relative Corpus," the latter a notion due to Hilbert somewhat analogous to the ideal numbers of Kummer.

The field of pure mathematics into which Dr. Sommer's book gives an insight has been somewhat neglected in France, and in England it is correct to say that nothing of any moment has been accomplished. German mathematicians have shown it to be a singularly attractive and fruitful if recondite subject of thought. Now that the field is brought closer to the view of English mathematicians it may be that they will take more interest in it.

The work, though on the whole well produced, is marred by many misprints in the early pages. On p. 41 there are six misprints, on p. 42 four, &c. It is a pity that difficulties already considerable should be thus increased.

P. A. M.

THE RESOURCES OF BRITISH WEST AFRICA.

The Agricultural and Forest Products of British West Africa. By G. C. Dudgeon. Pp. x+170, with five maps. (Imperial Institute Handbooks.) (London: John Murray, 1911.) Price 5*s.* net.

THIS book forms the introductory volume of a series to be known as the "Imperial Institute Series of Handbooks to the Commercial Resources of the Tropics, with Special Reference to British West Africa." The handbooks will be edited by Prof. W. R. Dunstan, F.R.S., and will be issued under the authority of the Secretary of State for the Colonies.

Mr. Dudgeon was for several years Inspector of Agriculture in British West Africa, and in that capacity visited annually the five colonies and protectorates which together form that territory. He writes therefore with full knowledge of the conditions under which agriculture and forestry are carried on there.

The five dependencies are dealt with in geographical order, commencing with Gambia to the west, and finishing with northern Nigeria to the east. By way of introduction to the section on each country, the salient facts regarding area, population, habits and disposition of the natives, and the peculiarities of the climate and soil are set out, followed by a brief account of whatever local attempts are being made to improve native methods. The improvement of native agriculture is largely a question of better tillage and the introduction of a proper rotation of crops, and from this point of view Mr. Dudgeon's brief but careful descriptions of the implements in use by the natives are of value. The greater part of each section is, however, occupied by descriptions of the principal crops, more detailed reference to any particular crop being reserved for the section relating to the dependency in which that crop is predominant; thus, under Gambia there is a good account of groundnut cultivation, and under the Gold Coast there is an excellent summary of the present position of the flourishing cocoa industry of that colony. These matters will, however, receive detailed attention in subsequent books of the series, and the author rightly confines himself in this volume to giving the reader a general idea of the agricultural and forest resources of each country and of the means whereby these may be most surely and safely developed.

It is clear from this book that the two chief obstacles encountered in the agricultural development of British West Africa are the lack of transport facilities and the ignorance and conservatism of the native population. The first of these obstacles is

being gradually surmounted by the provision of roads and railways, and the most recent enterprise of this kind, when finished, will connect by rail Kano, on the edge of the Sahara, with Baro, on the Niger, and Lagos, on the coast, and thus open out an immense area of land, much of which, it is believed, will be suitable for growing cotton of the type required in Lancashire mills. The second obstacle is more difficult to deal with, but there are indications in Mr. Dudgeon's book that advance is being made. Progress in this particular direction can only be accomplished by the provision of agricultural departments, staffed by men who are not only skilled agriculturists by training and education, but possess, in addition, administrative and managing abilities of a high order, and are capable of exercising initiative in face of great natural difficulties. It is fortunate for British West Africa that the days seem to be over when governmental assistance to tropical agriculture consisted merely in the provision of a botanical garden, and that the tendency in British West Africa at least, in recent years, has been to replace such institutions by properly equipped and staffed departments of agriculture, with their necessary complement of experimental stations.

Mr. Dudgeon avoids technicalities as far as possible, and for that reason this book will probably appeal, not only to the tropical agriculturist, but also to the Colonial official, whose interest in these matters it is most important to enlist.

The volume contains five clearly printed and useful coloured maps of the areas dealt with, and is well illustrated by reproductions of photographs of tropical crops and typical native industries.

OUR BOOK SHELF.

Modern Science Reader, with Special Reference to Chemistry. Edited by Prof. Robert M. Bird. Pp. viii+323. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* net.

IN this country "Readers" are usually intended for young children. In the States the use of "Readers" extends to a later period of study, and in the present instance the book provides a course for "college men" and general readers. It is a compilation of reprints of modern papers and professional addresses, and is the first volume of a series which, it is hoped, will broaden the outlook of the undergraduates for whom it is intended. In every instance, the authors and publishers of the original papers have consented to their republication in this handy form. The selection of subjects has been made with a judicious regard for the taste of the reading public, and as the authors include Crookes, Lodge, Remsen, and Madame Curie, the readers are provided with stimulating fare.

We think that there is a risk that the title "Reader" may militate against the circulation of the book in England. It would be a pity if this should prove to be the case, as all the subjects are worthy of study, and they are very skilfully treated by men who add to eminence as investigators the power of presenting the results of investigation in an attractive, intelligible form. Perhaps the most formidable, though not the least interesting, of the articles is Dr. Howell's address on activators, kinoses, and hormones.

The book concludes with suggestions for additional reading, such as are usually given here to university extension students. Indeed, the book is well suited to those who reap profit from the more advanced extension classes, and is likely to interest a rather wide circle of readers. It would be a good book for a school science library, as it is trustworthy as well as stimulating. Most of the articles made their first appearance within the last three or four years.

(1) *Gardens shown to the Children.* By Janet H. Kelman and Olive Allen. Described by J. A. Henderson. Pp. xii+100+32 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 2*s.* 6*d.* net. (Shown to the Children series.)

(2) *Roses.* By H. R. Darlington. Pp. xiii+193+8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price, double vol., 2*s.* 6*d.* net. (Present-day Gardening series.)

(1) As we all know, the love of flowers is with nearly every child almost a passion; there was no need of a book to create or develop that. The object of the authors of this work has been rather to teach children to take an interest in the methods of cultivation, and, by pictures, to broaden their knowledge of hardy plants in general. To write down to the child's mind on such a subject as gardening is no easy task, but if we imagine the authors' audience to be limited to children who have reached their 'teens, we think they may be congratulated on having accomplished it very well. They give sound cultural directions couched in simple, direct language without putting on the omniscient, patronising air that so many authors of serious children's books think it essential to assume. There are thirty-two coloured plates, some of which are very good considering the price of the work; others are decidedly painful—to the adult eye at any rate. But, after all, the best critic of the book is an intelligent member of the particular audience to whom it is addressed. We put our copy into the hands of such a one during the recent holidays and his opinion, expressed in vigorous schoolboy idiom was, when translated, found to be distinctly favourable.

(2) The work on "Roses," by Mr. H. R. Darlington, admirably maintains the high standard set by previous authors in this useful series of gardening books. The book is in the nature of a double number and the price is slightly increased, but no rosarian will grumble at that. The author gives very excellent directions for the propagation, management, and care generally of roses. Especially useful will be found lists of roses for different purposes and situations. There is a pleasant chapter by Mrs. Darlington on "Fragrance in Roses." A rose without fragrance is without half its charm; yet, a short time ago, as one ascertained for oneself at the big rose shows, it seemed as if that half was in fair way of being lost in the rose-raiser's quest for colour and form. Happily the claims of fragrance are being again admitted. The coloured illustrations are some of the best examples of colour-photography hitherto published in this series.

Elementary Integrals: a Short Table. Compiled by Dr. T. J. I'a. Bromwich, F.R.S. Pp. 38. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd.; Glasgow: James Maclehose and Sons, 1911.) Price 1*s.* net.

THIS is a very compact and serviceable *vade mecum* suitable both for students of physics and for those who are in the earlier stages of pure mathematics; and it is arranged on a system which ought to make its owner able to find quickly anything that it contains.

The work throughout is very elegant, especially in the treatment of integrals involving quadratic irra

tionalities, and there are various instructive notes. Stimulation is provided, for example, by the inclusion of some simple pseudo-elliptic integrals, and those who are familiar with Abel's theorem will see frequent traces of its application. Practical ends are served by the inclusion of Simpson's rule and the theory of the planimeter, and a sufficient number of examples for practice is given throughout.

The actual limits of the table are best seen from the section on definite integrals. Here we have, for instance, $\int_0^\infty e^{-ax}\cos bx dx$, but not $\int_0^\infty \sin ax.dx/x$. From his position at Cambridge, Mr. Bromwich has no doubt been able to fix the line at the most appropriate place; in a table of this sort it is not very easy to decide where to stop.

G. B. M.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Value of the "External" Degrees of the University of London.

It is often the case that a system, whether of Government or of social custom, passes muster until its shortcomings are brought to light by some specific instance of hardship or injustice. The reform introduced in the constitution and government of the University of London, due to the report of the Commissioners of 1898, was devised to remedy alleged shortcomings in the system of awarding degrees on examinations alone; and the "internal" side of the University was then constituted, in which the teachers were given considerable (but in the opinion of the writer, insufficient) control over teaching and examinations. In spite of the fact that purely "external" examinations (*i.e.* examinations in which the teacher takes no part) were unknown, save in London, in China (the system has since that time been altered there), and in New Zealand and in India (the latter two countries having copied the system in vogue in the University of London), it was resolved that this "external" system should be continued; it has ever since formed one of the divisions of the University.

It is a matter of common knowledge that this course has not made either for peace or for efficiency; and at the present moment Lord Haldane's commission is reconsidering the whole question of university education in London. It is rumoured that their decision may involve complete separation of the "internal" and "external" sides of the university. I wish here to give reasons why the "external" side of the university should not be perpetuated, and I base them upon an instance where flagrant injustice has been done to a late student of University College, Mr. F. P. Burt, whose permission I possess to make known the facts connected with his candidature for the D.Sc. degree in chemistry.

At a meeting which took place some years ago of representatives of the Sorbonne (the University of Paris) and of the University of London, I, among others, was asked to give a short address. I ventured then to point out that out of 100 candidates for an external examination, 25, on an average, were undoubtedly "passes"; 25, equally indisputably failures; but as regards the remaining 50 it was a matter of good luck if they passed, or of bad luck if they failed. I suggested that as an excuse for persistence in a system involving such haphazard results the well-known gambling spirit of the English was satisfied; they like to take a risk of the kind.

My remarks may have been somewhat exaggerated; I will not insist on the proportions; but it is indubitably the case that no proper judgment can be formed on the fitness of a candidate to pass which is based solely on the verdict of external examiners reading written papers. The number of candidates at such examinations is very large; the physical strain to the examiner in reading and "marking" hundreds of papers in a comparatively short time is immense, and with the best will in the world he cannot act fairly. I speak from ample experience, both in London and elsewhere.

For higher degrees, such as the Doctorate, it is within the discretion of the Senate to appoint examiners *ad hoc*, for it is not to be expected that the official examiners shall always be able to form an accurate judgment on the matter of a thesis of a special nature. This, however, the Senate does not always do on the "external" side; on the "internal" side, the services of a special examiner are rarely, or never, dispensed with.

While in 1858, when the degrees of the University of London were thrown open to all applicants, solely on an examinational test, with no restrictions (except in the faculty of medicine) as to how they had acquired their knowledge, some excuse might have been found for this course; but the spread of education, and the existence all over the country of teaching institutions where advanced instruction may be obtained, and in many cases where degrees are awarded, has rendered it practically unnecessary to provide for the "private" student. Indeed, in the faculty of science at least, very few students present themselves for examination who have not received training at some public institution, and many of them have received degrees elsewhere.

Mr. F. P. Burt, whom I mentioned before, was a student in University College, Bristol. He subsequently prosecuted a research, begun there, in the laboratories of University College, London. Having completed this research, he sent it to the University as an *external* student, without having consulted any members of the London staff. My position in connection with him is therefore merely that of an outside member of the public; I am in no way responsible for his thesis.

This thesis was received by the University last spring, and Mr. Burt was informed by the University authorities that it had not been accepted as qualifying for the degree. To those who knew the work, the refusal was so extraordinary that I sent copies of the thesis, which dealt with the atomic weights of nitrogen and sulphur, to three gentlemen, one of whom is a member of the International Commission on Atomic Weights, who publish an annual table, printed in all the leading chemical journals, stamped with their authority. It is their function to read and examine critically all the work on the subject done during each year, and to assign a value to it in drawing up their table of these constants. This gentleman, Prof. Ostwald, late of Leipzig, is, it may be taken, particularly qualified to judge of such work as that of Mr. Burt. The second referee was Prof. Th. W. Richards, of Harvard University, well known for his work on atomic weights; and the third, Prof. Guye, of Geneva, who has special experience of the kind of work done by Mr. Burt, and who is also a leading authority. I now give a translation of Prof. Guye's letter; he is himself a graduate of Paris:—

"*Geneva, June* 22, 1911.

"Sir William Ramsay has called my attention to the researches of Mr. Burt. I was already acquainted with them, through having followed them closely as they appeared. A fresh study of them has confirmed me in the opinion that they place Mr. Burt among the small number of experimenters capable of carrying out satisfactorily chemical researches of high precision. This opinion is derived from his researches on helium and neon, and on those on sulphide of nitrogen; they present very great experimental difficulties, which have been admirably surmounted, so much so that they form a very important contribution to the recent determinations of atomic weights. Work of this kind ought to be greatly encouraged, for it forms a particularly stable foundation in fixing the values of atomic weights. I hold the opinion that the memoir on the ratio of N to S would assuredly be accepted as a thesis for the doctorate in Swiss and in French universities.

"(*Signed*) PH. A. GUYE."

Prof. Ostwald also wrote a letter, of which the following is a translation:—

"*Gross Bothen, Saxony.*

"The collected works of Mr. F. P. Burt show him to be an experimenter who knows what to aim at and how to arrive at results. He appears to be already sufficiently mature to occupy a position which demands the services

of an independent investigator. Had his work 'On the Relative Atomic Weights of Nitrogen and Sulphur' been presented in Leipzig, I should gladly have accepted it, not only as a doctor's dissertation, but also as a sufficient qualification for the position of university lecturer (Privat-dozent).

"(*Signed*) WILHELM OSTWALD."

Prof. Th. W. Richards wrote:—

"The investigations of Mr. F. P. Burt seem to me to present many points of interest, and to indicate a high order of experimental ability. In view of the fact that a large proportion of the work was done by Mr. Burt himself, even when he was assisted by collaborators, the sum total of his papers appears to me to present more than the equivalent of a thesis for the doctor's degree in the best universities in America. It must be remembered, however, that a thesis is only a part of our requirement.

"(*Signed*) THEO. W. RICHARDS."

Copies of these letters were sent to the Senate of the University of London in July, 1911, together with a letter, the last sentence of which is:—"Since it appears to me (and my opinion is shared by Profs. Dixon and Collie) that an error of judgment has been made in Mr. Burt's case, we would respectfully urge you to reconsider his claims."

On October 18, 1911, the Senate passed the following resolution:—

"That, having considered the communication from Sir William Ramsay of July 10, 1911, and having heard a report from the examiners, the Senate are not prepared to vary the decision at which they have arrived."

As it was impossible to believe that the Senate attached more importance to the decision of their examiners on the merits of the thesis than to the verdict of special experts, the inference was obvious that they considered that the work, or a sufficient proportion of it, had not been done by the candidate. Perhaps this view was partly justified by the terms in which Mr. Burt had thanked all those to whom he supposed himself indebted during the progress of his research; his expressions were, to say the least, generous.

The Regulation for External Students (Blue Book, Univ. of Lond. Calendar, p. 294) is:—"If the Dissertation or Thesis be approved by the Examiners, the Candidate shall be required to present himself . . . to be further tested either orally or practically, or by printed papers, or by all these methods. . . ." But in certain circumstances the candidate may be exempted.

It was therefore within the powers of the examiners to have interviewed the candidate, to have asked him the nature of the assistance which he acknowledged, and to have obtained from him the names of the persons assisting him, and, should his word have been doubted, to have written to them inquiring as to the extent and nature of the help given. This was not done. Hence it appeared necessary to obtain from all those who knew of Mr. Burt's research testimony as to the share they had had in it. Prof. Travers, Prof. Usher, Prof. Francis, and Dr. Whytlaw Gray all testified most emphatically that the share which they had borne in the work was insignificant, and that the work was in every sense of the word original. Prof. Dixon, in whose laboratory Mr. Burt is now assistant, although not having been in contact with Mr. Burt during the progress of his thesis research, voluntarily wrote to me expressing the opinion that work in which Mr. Burt is at present engaged is being done "in a masterly manner," and that he has "no doubt as to the capacity, manipulative skill, foresight, and patience which Burt possesses to carry out such work."

Copies of these letters were sent to the Senate on November 27, 1911, and they were again requested to reconsider their decision not to admit Mr. Burt "to be further tested." On January 25, 1912, the Senate resolved:—"That the Senate decline to reopen the question of the rejection of the D.Sc. candidate referred to."

After this final refusal no course remains but to make public the facts of the case. And this I do, not so much in justice to Mr. Burt, but in order to raise the much larger question as to whether it is proper that a system in which such injustice can be perpetrated should continue to exist. I am led to understand that complaints are not infrequent that candidates of undoubted merit, not only in the faculty of science, but in other faculties, have had their theses rejected without sufficient reason. There is one instance, at least, of a thesis which, after summary rejection, was subsequently published in book form, and which received the highest encomiums from the Press and from private persons of eminence in the subject treated. On the "internal" side of the University I am unaware of any complaint having been made, for much more care is bestowed; and besides, the teachers, who are also examiners, are acquainted with the candidates' abilities from frequent personal communication, and often from daily contact.

There can be no doubt that such miscarriages of justice are to be attributed, at least in part, to the growth of the University. With few candidates some sort of acquaintance on the part of the examiners with their merits is possible, but with increase of numbers control becomes impossible. Moreover, there is a growing reluctance on the part of men of established reputation to accept the post of examiners; the work is hurried, it is badly paid, and it is a thankless task. The fact is that the day of "external" examinations is past; the system is an anachronism; and I think that the case which has been presented furnishes an irrefutable argument why that system should be abandoned. A degree is in essence a testimonial; and a testimonial from a corporate body depends for its value on the eminence of the persons capable of forming a judgment on the merits of the graduate and on their opportunities for forming a correct judgment. Where the examiners are not eminent, and where the opportunity of forming a judgment has not been given or has not been taken, the degree is worthless, and the corporate body awarding it should cease to exist.

W. RAMSAY.

University College, Gower Street, London, W.C.

Are Eyes ever Autophanous?

THOSE who read Colonel Herschel's letter in NATURE of January 18 may be interested in some observations which I made during the summer upon the sight and eyes of cats. Whereas in men and monkeys the retina is backed by black pigment, as a photographer backs a plate when his camera is to be directed towards a window, in almost all other mammals it rests on a brightly burnished layer of cellular or fibrous tissue, the tapetum. It is this mirror which throws the light back to an observer who stands between the animal and the source of light. The eye is at the same time a camera focussed to form an image of the observer on its sensitive screen and a lantern focussed to project light upon the observer. Such an arrangement appears to a photographer fatal to the formation of an image sharp in line and dot.

Many explanations of the function of the tapetum have been offered, but none, to my thinking, satisfactory. To me it has long seemed that its only purpose can be to render the eye sensitive to movement, as distinguished from form. I studied my cats as they hunted field-mice. One of them would crouch for hours in front of a hedge. Seated at a moderate distance, I was able on several occasions to see the catch, a single spring in the direction of the mouse, whether it moved at the spot at which the cat appeared to be staring or considerably to one side or the other of the axis of her head. For movement her vision was perfect. If, as she roamed about the lawn, a daddy-longlegs shook a blade of grass, she sprang towards it. But to stationary objects she paid scant attention. In various places I fixed a dead mouse in as natural an attitude as I could make it assume with the aid of wires and wooden pegs. If the cat passed close to it she would stop to smell it, perhaps to pat it, but she never showed any sign of regarding it as something to be caught. In hunting for birds, on the other hand, her whole method was reversed. Cautiously climbing, she would study a dead leaf with the utmost care, afraid to move lest she should disturb a possible victim.

It seemed to me that the upper and lower halves of the retina functioned in different ways. I therefore examined the eyes of several cats. When perfectly fresh, the interior of the eyeball, seen under a dissecting microscope, is one of the most marvellously beautiful obects that can be conceived. The opalescent retina rests on a silver mirror

mottled with gold. The surface of the mirror is raised in low ridges, which radiate outwards from the centre in waving lines, like the sun's rays on the Japanese flag. After a few minutes' exposure to air or water a film of metallic green and blue invades the silver. But the tapetum does not line the whole of the back of the eye. It is bounded by a sharp irregular line which crosses the wall of the globe horizontally, about 1 mm. below the level of its equator. The lower portion of the retina, a little less than a quarter sphere, is backed, as it is everywhere in the human eye, by dense black pigment. Colonel Herschel observes that a man's eye does not gleam.

In a superbly illustrated monograph published in the Philosophical Transactions of the Royal Society Dr. Lindsay Johnson pictured the eyes of a great number of the animals in the Zoological Gardens as he saw them with an ophthalmoscope. With the exception of monkeys, the elephant, rhinoceros, and hyrax, all terrestrial mammals are provided with a tapetum. The exceptions are significant. In monkeys, as in ourselves, the retina shows a "yellow spot." They trust to direct vision with its minute discrimination of detail. They move their eyes with great rapidity towards the objects which they wish to examine. Such rapid movement is incompatible with extreme sensitiveness to the movements of external objects. A cat does not move its eyes. It moves its head. Of hyrax I have nothing to say, but the elephant and the rhinoceros stand alone amongst Herbivora. They alone are indifferent to the movements of lurking enemies—great cats and snakes. They do not need to sacrifice visual precision, as it must be sacrificed in animals in which the retina is backed by a mirror, in favour of a capacity of detecting movement.

I have examined the eyes of a considerable number of animals, and find that the disposition of the tapetum, considered in its relation to the habits of the animal, is in all cases in harmony with the view as to its purpose which I have here expressed. I am also prepared to give an explanation of the optics of its relation to the retina, but for this or for special illustrations I must not trespass upon your space.

ALEX HILL.

COLONEL HERSCHEL'S letter in NATURE of January 18, followed by that of Mr. Hunt, have no doubt interested others besides myself. I do not think that there is any reason to suppose that any animal's eyes are "autophanous," however general the belief to the contrary may be among those not given to accurate observation. I can add to the list of the apparently autophanous the springhaas in South Africa and the common English mouse. I generally encourage a few of the latter, and at the present time three have taken up their abode with me in Victoria Street. There is a regulator clock standing $1\frac{5}{8}$ inches away from the wall, and about 6 feet high. I put a little food on the top of the clock, and sometimes behind the clock not quite so high, and in other awkward places. The mice jump on to the skirting board, and there spread themselves out sideways so as to stretch the $1\frac{5}{8}$ inches, and then proceed to go up at an angle of about 40°, climbing, so to speak, a staircase that is not there, and then when this brings them to the side of the clock they turn over in a nimble way with a jump, not always successfully, and negotiate the next flight, and so zigzag to the goal. I often watch these quite close, holding a metallic filament electric light with shade, so that they are fully illuminated and I am in shade. So long as I am quiet or move slowly, doing nothing spasmodically, they take no notice. I have even prodded and moved the food they were eating with the slide of a long rule, which seemed to perplex rather than frighten them. They do not seem to hear loud noises or singing provided they do not contain S, K, or other sudden sounds, even though I am not a yard away. A few days ago while writing I heard one at work on some bread about 4 feet from the ground, when, to see him better without getting up, I focussed the filaments of the electric lamp upon him with a large reading-glass. The mouse did not seem in the least frightened, but stared at the lens a short time, and then I saw his eyes shining with a pale ruby, or rather spinel, colour, and was reminded of Colonel Herschel's letter.

The same action which makes animals' eyes appear "autophanous" is seen in far greater perfection in that invaluable little instrument called the reflex light, now used in large numbers to protect the bicyclist from being run down by a motor-car at night. The bicyclist's lamp, of course, is useless, as its light in the road is outshone by that of the motor-lamps, and the lamp itself is generally not directly visible from behind. The bicycle and rider, too, are often by no means conspicuous objects, and the danger of being run down is a real one. To meet this, the reflex light has been invented. It may be considered to be a glorified cat's eye. All that is visible from the outside is a ruby bull's-eye lens, but inside, in the principal focus of this lens, there is placed a concave silvered reflector of half the focal length, *i.e.* the bull's-eye is at its centre of curvature. Any strong light shining upon the bull's eye is therefore brought to a focus on the surface of the mirror, and whether the light is directly in front of the lens, or on one side even to a surprising degree, the focussed light falls normally upon a portion of the reflector, which sends it back to the lens, and so in a parallel beam in the direction from which it came. The driver of the car and his lamps subtend so small an angle at a distance of, say, 200 yards, or very much less, that the reflected light is seen by the driver like a red lamp. The committee of the Associated Automobile Clubs were so impressed with the value of this device that the technical committee of the Royal Automobile Club, of which I am a member, examined and tested the reflex light, and they issued a certificate endorsing the claims made for it. There is a feeling that every cart in the country should carry one, which, unlike ordinary lamps, would entail no trouble or running expense, and would be free from all risk of fire. This reflex light beats any cat's eye or other animal's eye, but it is not autophanous.

C. V. BOYS.

THE experiments described by Colonel Herschel in NATURE of January 18 illustrate the reflecting power of animals' eyes, and give no support to the general view that the eyes of cats and dogs "shine in the dark," that is, in the absence of any external source of luminosity. The principle of the experiments is illustrated by the Reflex Lamp commonly fixed at the back of the frame of a bicycle in rural districts. This is not really a lamp, but a bull's-eye of ruby glass about 2 inches in diameter, fixed with the convex surface directed behind the bicycle. When a carriage or motor is approaching the bicycle from behind, its lamps illuminate the bull's-eye, and the reflection is so clear that the driver knows a cyclist is in front of him long before the rider or the machine can be seen. The candle-light used in ordinary carriage lamps enables the Reflex Lamp to be visible at a distance of a hundred yards or so on a dark night. The conditions are precisely similar to those described by Colonel Herschel, the only difference being that a glass convex lens takes the place of the 'animals' eyes.

R. A. G.

January 27.

Glazed Frost; a Reminiscence.

MR. HARDING'S letter (NATURE, January 25, p. 414) reminds me of an experience which, in view of the rarity of the phenomenon, may be of sufficient interest to place upon record in these columns, although the newspapers of the period—the sixties of last century—duly noted the occurrence. It must, I think, have been in 1866 or 1867 (date and year uncertain) that I had occasion to go from the West to the East End of London. Starting upon my journey about 10 p.m., it began to rain soon after I left the house in Bayswater, and I opened an umbrella, which, to my surprise, became stiffer and heavier every moment, and was found on examination to be so thickly glazed over with ice that it was impossible to close it. At the same time the pavements and roadway were also becoming uniformly glazed; pedestrian movement was most difficult, and all horse traffic was suspended. Although an experience of some forty-five years ago, the impression left upon my memory is still vivid—the ludicrous sight of people carrying ponderous and rigidly frozen umbrellas which they could not close, the stream of skaters down Oxford Street

and Holborn, and the silence due to the absence of vehicles, all came to mind on reading Mr. Harding's letter. It took me on that occasion more than four hours to perform a journey of about two miles, and progression was only made possible by encasing my boots in the folds of a woollen scarf which I was wearing at the time, which I took off and cut into two portions for the purpose. There was no viaduct at that time, and Holborn Hill interposed serious difficulties.

The explanation of the phenomenon is no doubt that given in "The Observer's Handbook" quoted by Mr. Harding, viz. the sudden freezing of supercooled water drops on shock. In connection with this explanation there naturally arises the question as to the particular conditions which admit of supercooling without actual conversion into hail. Clearly these conditions are but rarely complied with. The actual date could no doubt be found by hunting through newspaper files, but there must be many Londoners now living who can remember the occasion.

January 26. R. MELDOLA.

The Radiating Power of Air.

IT has been assumed in investigations of atmospheric radiation that the values of the radiating power obtained in laboratory experiments are comparable with the values obtained from meteorological observations, and agreement between values obtained by the two methods has been quoted as evidence of the accuracy of the determinations. In an investigation of the problem from the meteorological side, I discovered that the quantities used to represent the radiating power were different in the two cases, and the distinction is important.

In the meteorological method, if θ is the temperature of the air at time t during the night, values of α, θ_0 are found to satisfy approximately the equation

$$\frac{d\theta}{dt} = -\alpha(\theta - \theta_0) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and $\alpha\rho c$ is taken to represent the radiating power of the air, where c is specific heat, 0·239, and ρ is density.

If the radiation from a horizontal layer of air 1 cm. thick is $f(\theta)$ per unit area from each face, the absorption by it will be $2f(\theta')$ per unit volume if its surroundings are at temperature θ'. In that case

$$\begin{aligned} \rho c\frac{d\theta}{dt} &= -2\,[f(\theta) - f(\theta')] \\ &= -2\,(\theta - \theta')\frac{\partial f}{\partial \theta} - \text{higher powers of } (\theta - \theta') \quad . \quad . \quad (2) \end{aligned}$$

and by comparison with (1) it is seen that

$$\alpha\rho c = 2\frac{\partial f}{\partial \theta},\ \theta_0 = \theta'.$$

Now, in laboratory experiments on the radiation of air, the quantity measured is the excess of the radiation per unit area from one face of a column or layer of hot air over the corresponding radiation from a column or layer of cold air, and this quantity, reduced to 1° C. difference of temperature for a layer 1 cm. thick, is denoted by h, and is used to represent the radiating power. Clearly $h = \frac{\partial f}{\partial \theta}$ and *consequently* $\alpha\rho c = 2h$, *and not* h, *as hitherto assumed.* If in the laboratory experiments the radiation emitted by the layer in a direction perpendicular to its face is compared with that emitted normally by a black surface, the value of h will be only $\frac{1}{2}\frac{\partial f}{\partial \theta}$ or $\frac{1}{4}\alpha\rho c$, since the ratio of the total radiation to the normal radiation is π for the black surface but 2π for a thin layer of air.

The confusion arose from the fact that h and $\alpha\rho c$ were taken to represent the rate at which air is losing heat by radiation to surroundings 1° C. colder, but while in the case of $\alpha\rho c$ the radiation in all directions was taken into account implicitly, in the case of h the necessary adjustment was not made. E. GOLD.

4 Hurst Close, Hampstead Garden Suburb, N.W.

Microscope Stands.

A LENGTHENED experience in the use of the microscope impels me to ask you to allow me to take exception to one of the statements made by the writer of the article on microscope stands which appears in NATURE of January 11. Referring to the circular rotating and centring stage of the better class of Continental stands, the writer says, "the use of which for anything but petrology it is difficult to guess."

After working for upwards of thirty years with an English stand, and, especially during the latter part of that time, constantly feeling the desirability of a rotating stage, I decided three years ago upon the purchase of a new stand, and the circular rotating stage was the feature that led me to decide upon one of Continental manufacture, after carefully considering the merits of two of English manufacture. If well made, the rotating stage is of great utility. If one wishes to examine, and especially to draw, say, one of a number of scattered Ophiurid or Echinoid plutei, it is a great convenience to be able to bring its sagittal plane into a vertical position in the field of view, and, as I know from much irritating experience, this is seldom possible on a fixed rectangular stage provided with mechanical adjustments, or even a sliding bar.

What is really needed to make the rotating stage of the Continental microscope much more efficient is a removable sliding bar, upon which it would be possible to support a $3 \times 1\frac{1}{2}$ inch slip, so that a series of sections mounted upon it might be examined carefully with the microscope in an inclined position. The rotating stage of a high-class stand by one of the foremost English makers, now before me, is provided with such a bar, which slides in a groove cut in the stage; but its utility for the purpose indicated above is nullified by the projecting heads of two screws which hold together parts of the mechanical adjustments, and the whole instrument is little more than an ornament on my work-table.

I have never found any use for the excentric rotating movement below the Abbe condenser, and especially for the cylinder diaphragm, which, I suppose, is a sop thrown by Continental makers to those teachers who, in my student days, derided the use of any form of substage illuminator. In my opinion the expense incurred in the manufacture of these redundances might with great advantage to workers like myself be devoted to the improvement of the stage on the lines I have indicated.

H. C. CHADWICK.

The Biological Station, Port Erin, January 26.

Meteor-showers.

THE following meteor-showers become due in February. The epochs are arranged according to the times of the principal maxima:—

Epoch February 4, 3h. 30m. (G.M.T.), fifth order of magnitude. Principal maximum, February 3, 8h. 55m.; secondary maxima, February 3, 3h. 40m. and 20h. 20m.

Epoch February 3, 9h. 30m., nineteenth order of magnitude. Principal maximum, February 4, 21h. 15m.; secondary maxima, February 4, 11h. 25m., and February 6, 6h. 50m.

Epoch February 9, 4h., twenty-first order of magnitude. Principal maximum, February 10, 8h. 40m.; secondary maxima, February 10, 1h. 30m., and February 11, 8h. 25m.

Epoch February 13, 11h., fifth order of magnitude. Principal maximum, February 12, 13h. 45m.; secondary maxima, February 11, 22h. 30m., and February 13, 10h. 45m.

Epoch February 14, 11h. 30m., thirty-third order of magnitude. Principal maximum, February 15, 22h. 45m.; secondary maxima, February 14, 11h. 35m., February 15, 15h. 30m., and February 16, 7h.

Epoch February 16, 8h., approximately tenth order of magnitude. Principal maximum, February 17, 0h. 30m.; secondary maximum, February 17, 15h. 40m.

Epoch February 19, 1h., approximately thirteenth order of magnitude. Principal maximum, February 18, 5h. 40m.; secondary maxima, February 18h., 3h. 40m., and February 18, 18h. 55m.

Epoch February 20, 7h., fifteenth order of magnitude.

Principal maximum, February 20, 12h. 20m.; secondary maxima, February 20, 17h., February 22, 7h. 45m., and 16h. 30m.

Epoch February 26, 3h. 30m., approximately fourteenth order of magnitude. Principal maximum, February 24, 7h. 50m.; secondary maximum, February 24, 22h. 50m.

Epoch February 26, 14h., fourteenth order of magnitude. Principal maximum, February 25, 23h. 20m.; secondary maximum, February 24, 9h. 50m.

Epoch February 27, 23h., approximately sixth order of magnitude. Principal maximum, February 28, 6h.; secondary maximum, February 29, 9h.

Epoch February 27, 14h. 30m., third order of magnitude. Principal maximum, February 29, 6h. 30m.; secondary maxima, February 27, 23h., and February 28, 12h. 40m.

There is a considerable number of meteor-showers in February, but the meteoric activity of the month is, in general, not so intense as in January. The most important epochs in the foregoing list are the second and the last five.

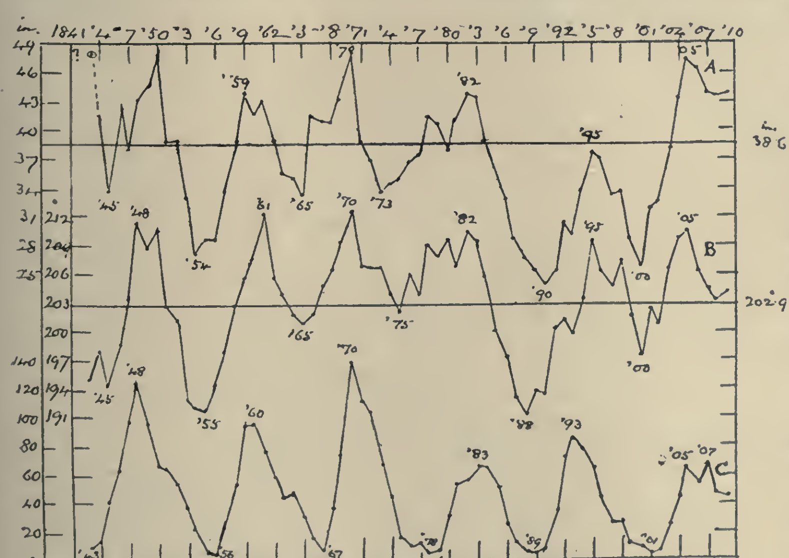
JOHN R. HENRY.

January 29.

The Question of Sun-spot Influence.

IN a paper to the *Meteorologische Zeitschrift* (September, 1911), Dr. Magelssen, dealing with sun-spot influence on temperature, finds this influence, at Christiania, &c., most apparent in the winter half of the year. This is borne out, I think, by the data for Greenwich.

We might approach the matter thus: Taking the six maxima and six minima since 1841, and confining attention to the groups "max. 1, 2" and "min. 1, 2," let us ask how many warm Januarys, Februarys, &c., there were in those years (eighteen in either case). The most pronounced contrast (between maximum and minimum groups) thus comes out in the early part of the year, and (localising further) in the pair February-March.



A. Rainfall, Rothesay, February-March; smoothed, with sums of 5.
B. Mean temp. Greenwich " " "
C. Sun-spot curve.

If, now, we take the annual values of mean temperature for February-March, and smooth the series by simple addition of the groups 1841–5, 1842–6, and so on, (this is sufficient), we get the curve B in the diagram.

Now, if we handle the monthly *data* of Rothesay rainfall in the same way, a maximum contrast comes out, similarly, in the early part of the year. Then, taking the annual amounts for February-March, and smoothing with sums of five, we have the curve A.

Below is the sun-spot curve, and it is remarkable, I think, to find things so far apart as Rothesay rainfall and Greenwich temperature in the February-March group presenting so much correspondence with each other and with the undulations of the sun-spot curve.

(The first point of the curve A I have marked as doubtful, for reasons I need not here enter into.)

ALEX. B. MACDOWALL.

The Occurrence of Peripatus on the North-East Frontier of India.

THE following extract from a letter just received from Mr. S. W. Kemp, zoologist with the Abor Expedition, will, I think, be of interest to the readers of NATURE, as it announces the first discovery of the Prototracheata in what may properly be called Continental Asia. The latter is dated Rotung, December 20, 1911:—

"Yesterday I toiled up to Kalek (3800 feet). . . . On my return Hodgart, Mr. Kemp's assistant, rushed up with Peripatus in a tin, caught about 20 yards from me—one adult and two young. . . . This morning we toiled for about four hours and got nine or ten more adults and a number of young. They occur over an area of about 30 square yards, and apparently nowhere else. The camp is made on an old Abor clearing. Prior to our occupation it was scrub jungle about 6 to 8 feet high, with a few large trees, mostly jack-fruit, interspersed. The scrub has been cut all round the camp, and on the north side, at the top of the steep bank dropping down to the Dihong River, Peripatus is found under large stones in comparatively dry earth."

Mr. Kemp has as yet no opportunity of examining his specimens in a systematic manner; it will be of great interest from a geographical point of view to discover their genus in a restricted sense.

N. ANNANDALE.

Indian Museum, Calcutta, January 11.

Amphibian Faunas of South Africa and Madagascar.

IN reference to the question raised by the reviewer (NATURE, December 14, 1911) of my paper on the amphibian faunas of South Africa and Madagascar (Annals Transvaal Museum, April, 1911), the distribution of the genus Rana suggests that it originated in the Old World some time subsequent to the isolation of Madagascar and the disruption of the Brazil-West African land bridge, its passage to the New World being effected by a more northern bridge, probably the Bering Straits connection. The other Ranid genera of central and tropical America are unknown to me, but, judging from the descriptions, they form quite an isolated group, and if genetically related to the Old World Ranidæ had their origin, not in the specialised genus Rana, but in a more primitive Ranid stock which entered the New World by the Brazil-West African bridge.

JOHN HEWITT.

Albany Museum, Grahamstown, South Africa, January 4.

A Bright Fireball.

ON December 17, 1911, shortly after 5 p.m., while watching the dying glories of one of the loveliest sunsets I have ever seen, I saw a meteor fall in the west and burst into about twenty most brilliant balls, like an exploding rocket. I estimate that it appeared when about 20° above the horizon, and traversed perhaps 5° before bursting. It left a vertical and broad streak of white light on the sky, which very slowly became deflected from the perpendicular to the N.W., and when at about an angle of 45° it faded gradually into two patches of white cloud, which ultimately assumed a horizontal position. These retained their pale white colour until after the other clouds had become quite dark, and they did not disappear until they were obscured by some of these clouds passing over them. It was seen from Beni-Hassan on the Nile, 167 miles south of Cairo, from the deck of one of Cook's steamers.

J. C. C.

Aswan, Upper Egypt, January 19.

AN ADAPTIVE PEOPLE.[1]

THE British Protectorate of Uganda has the distinction of possessing one of the most perfect types of a barbarous people to be found in the world.

FIG. 1.—Drums of office. From "The Baganda."

The Baganda are a Bantu race, exceptionally well built and healthy. Courteous and sociable, they are to a remarkable degree exempt from social vices and perversions. They have "gone straight," as it were, while other races of the same level have gone crooked. Their only weakness seems to have been one frequently resulting from religious fervour, namely, a predilection for human sacrifice. Their physical evolution similarly has been free from perversions; they have not, as so many barbarians have done, tampered with their bodies, and they practise no form of cutting, scarification, or mutilation. Intellectually they are remarkable for an extraordinary faculty of imitation, "especially in all kinds of mechanism. Give a man time to examine an object, and he will apprehend the mode of its construction, and will go and produce one so much like it that it is often well-nigh impossible to tell which is the original. Chairs, tables, shoes, &c., have each in their turn been closely copied. This power of reproduction extends to house-building in all its details; thus there are numbers of houses made of sun-dried bricks, with iron roofs, which the natives themselves have built and completed without any supervision from Europeans. This trait of imitation is noticeable even in small children, who may be seen making toy guns, after the pattern of those used by their fathers. These toy guns are often so well made that, when the triggers are pulled, they make a sharp report. Bicycles have been cleverly imitated by boys, with wheels and spokes made of reeds."

Their social rites are numerous and remarkable; they give the impression of being rather a living organic system than a structure of hide-bound superstition. If their social religion can be separated from their theological doctrine and hierological practice, the former appears to have played a more important part than the latter, though this was well developed in the way of temple establishments, divine beings, and priesthoods.

Their economic and industrial system deserves careful study. Every household has its garden, and the garden makes it absolutely self-supporting. Even the bark-cloth garments, as picturesque in certain fashions of wearing them as Roman togas, are grown in the garden, each possessing several bark-cloth trees. But behind the household is the clan. The clan not only regulates kinship and marriage, but acts as a friendly society, insurance company, and general cooperative body. Thanks to the clan system, poverty does not exist. The clans are totemic, each possessing a primary and a secondary totem. Descent and inheritance were in the male line; but in the royal family the system was maternal.

In view of the solidarity of the family, the clan, and the people as a whole, their idea of "impersonation" is significant. An heir "not only takes the office of his predecessor, but so impersonates him that it is common to hear a man telling another that he is the father or the chief of a person who is known to have died years before." A similar continuity is secured by another method in the case of the kingly office. The spirit of the dead king enters a medium, who is consulted at the Temple of the Jaw-Bone. This relic of the dead king, together with his

FIG. 2.—Stocks for arms and legs, with plantain-fibre pads worn to protect the arms and legs from the sharp edges of the wood, and coil of rope for binding prisoners. From "The Baganda."

[1] "The Baganda: an Account of their Native Customs and Beliefs. By the Rev. John Roscoe. Pp. xix+547+2 plans. (London: Macmillan and Co., Ltd., 1911.) Price 15s. net.

umbilical cord, serves as an attachment for the spirit, which is *en rapport* with them.

The polity and government of the Baganda was a very perfect form of that kind of feudal monarchy which is frequent in Africa. The description of this system, and particularly of the functions of the King, forms the dominant feature of Mr. Roscoe's book. It is a remarkable chapter in political evolution.

The royal family is distinguished by a straighter nose and less protruding lips. Its descent is traced back, along with the history of the people, for thirty-two generations, about a thousand years, to the first monarch, Kintu, who made the Baganda a nation. Oral history of this type is a very real thing, transcending time and space more efficiently than written records, and probably avoiding many errors inseparable from literature. The other great landmark of Uganda history is the reign of King Mutesa in the middle of last century. Mutesa was a broad-minded and far-seeing ruler. He initiated liberal reforms, and broke away from the previous policy of isolation. It was by him that Speke was welcomed in 1861, and Stanley in 1875. Through the latter's representations Christian missionaries were admitted. But Mutesa also welcomed the Arabs. After his death there was a struggle between the Christian and Muhammadan parties for the succession to the throne, which was ended by the British Protectorate.

The succession, it may be noted, is hereditary, but a committee of chiefs selects and appoints one of the princes. There is much that is equally logical among the rights and duties as between king and chiefs and clans. Take away from the states of mediæval Europe their Greco-Roman culture and inheritance, and you have a civilisation little, if at all, more advanced, both politically, socially, and industrially, than that reached independently by the Baganda. The king is invested at the coronation by "the King's Father." The "Father" says to him: "You are king. Rule over your people well, and always do what is right." The king answers: "I agree to do so." "Always give just judgment." "I will." Side by side with this is the curious custom of killing men so that their lives may invigorate the king. But such atrocities, though differing in intention, have actually been more common in Europe.

Mr. Roscoe has lived with the natives for twenty-five years. He not only knows their character and customs, but has studied them as an anthropologist. His book is full of new and important facts which only scientific insight could have unearthed. Both the ethnologist and the constructive sociologist will find it the most significant and valuable study of a native race that has appeared since "The Northern Tribes of Central Australia." Nor must the author's human quality go without mention. There is an indefinable atmosphere of sympathy permeating his pages, the result of which is that the people as he describes them are a living reality.

A. E. CRAWLEY.

THE EVOLUTION OF AN AËROPLANE.[1]

READERS of the first two numbers of the twenty-seventh volume of "Smithsonian Contributions to Knowledge," who have not forgotten the pleasure they derived from the study of Dr. S. P. Langley's work in aërodynamics, will welcome the publication of this third number, on mechanical flight. While experimental aërodynamics and the theoretical study of flight respectively may form the sole subject of an investigation, the successful flight of models and of full-scale machines cannot be attained without both the guide of theory and the possession of accurate numerical data gathered by means of careful experiments. Appeal to nature is even necessary to obtain, through the observations of bird flight, some starting point in a line of research by trial and error that cannot be struck at random. For this reason the pursuit of success in actual flight is the most comprehensive branch of the science of aviation, and it

FIG. 1.—Burners, aeolipiles, and separators.

will be enough to say that the work before us deals with the history of Dr. Langley's efforts to realise artificial flight to convey the impression that the account put before us is pregnant with details of the utmost interest to men of science and to non-technical readers alike.

Those indeed who have appreciated Dr. Langley's indomitable perseverance in overcoming the ever-recurring obstacles that stand in the way of any experi-

[1] Smithsonian Contributions to Knowledge, vol. xxvii., No. 3: "Langley Memoir on Mechanical Flight." Part i., 1887 to 1896. By S. P. Langley. Edited by C. M. Manly. Part ii., 1897 to 1903. By C. M. Manly. Pp. xi+320. (Washington: Smithsonian Institution, 1911.)

mental achievement, and have an idea of the endless chain of linked difficulties that runs through the whole problem of mechanical flight, cannot fail to recognise that no better man could have harnessed himself to its solution, and will open the book with a feeling of expectation which, it is needless to say, does not end in disappointment. The gradual evolution of a full-size gasoline-propelled flying machine from a shellaced paper model propelled by twisted india-rubber is presented with a faithfulness and a precision of details that render the story most fascinating.

Two things, in our opinion, concur in making the tale unfolded before us specially captivating. The first is the impartiality with which both successes and failures are recorded, the latter being rightly judged as important and as worthy of being fully reported as the former; to quote Mr. Manly: "To such men as Mr. Langley, an unsuccessful experiment is not a failure, but a means of instruction, a necessary and often invaluable stepping-stone to the desired end." The second and chief cause of sustained interest is undoubtedly the special circumstances in which the work was undertaken, for, although small toys had been made to fly a few yards, yet, at that time, "hardly any scientific men of position had made even preliminary investigations, and almost every experiment to be made was made for the first time." The book is therefore, we believe, perhaps unique in its kind, being a complete record of the production of a highly complex and novel machine from an initial stage where very little help was available, not even an idea of the proportion of sustaining surface area to weight, which had to be gathered from measurements on birds, nature supplying the first—and misleading—data in an almost virgin field of knowledge.

The aim of the research is stated simply to be "putting a trial aërodrome—to use the name adopted by the investigator—successfully in flight, and thus giving an early demonstration . . . that mechanical flight is possible, by actual flying." We shall leave the reader to judge if such a modest statement adequately describes the strenuous endeavour to overcome the manifold difficulties, by gathering highly specialised knowledge in widely different fields of technical attainment until a new science was found to have sprung from the harvest of accumulated data and the acquired experience.

The work is divided in two parts. Part i., written by Dr. Langley himself, deals in chronological order with the flight of models, in ten chapters retracing the successive attempts, beginning with india-rubber models similar to those previously constructed by Pénaud. This portion of the book (chapter ii.) is by no means the least interesting, owing to the fact that practically every difficulty experienced later was met at the outset, the structure being too heavy if able to bear the strain, or too fragile if sufficiently light, while even the difficulty of launching, that was to require so much skill and ingenuity later, was felt at this early stage. A short discussion of the available propelling agents and the history of the special type of steam engine finally found to answer the contradictory requirements as to power and weight is the subject of the next two chapters, and goes far to show that the key to success was the determination with which the word "disheartening" was cancelled from the dictionary of the experimenter and of his able assistant.

Sustaining surfaces and "balancing" are then shortly dealt with. The relative importance of skin friction is not touched upon. The important subject

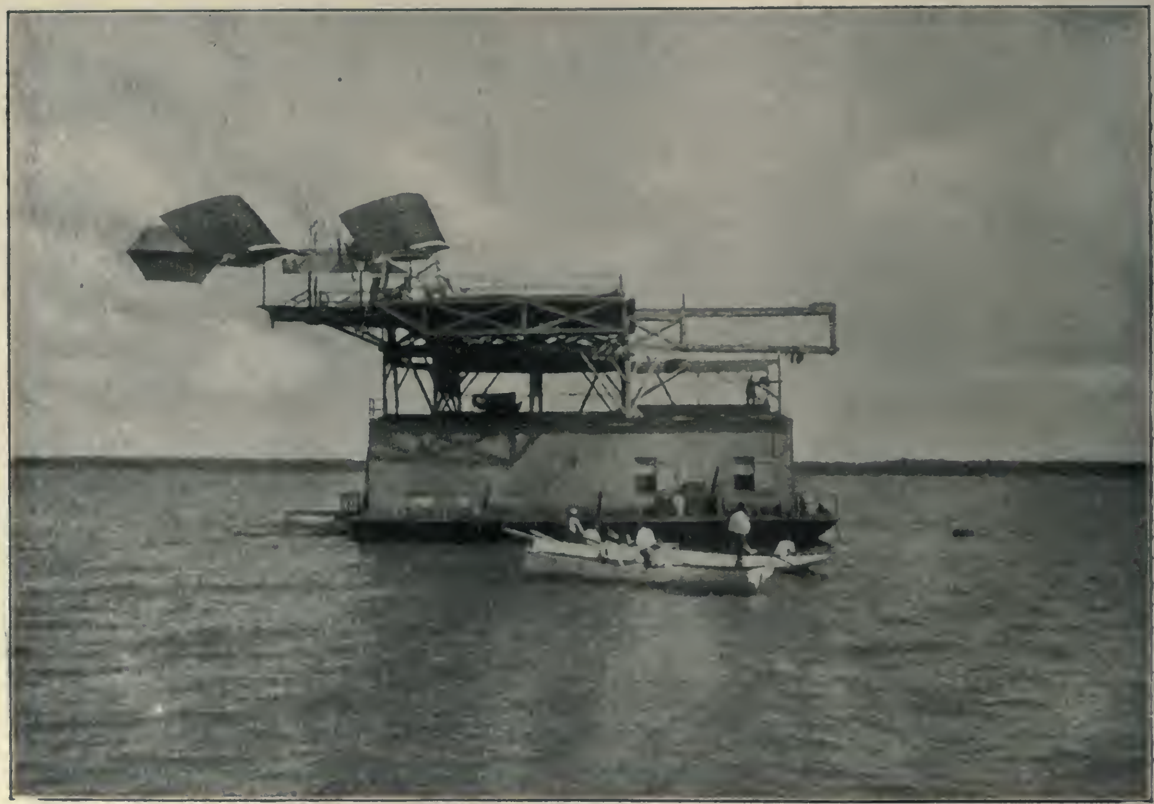


FIG. 2.—Front end of track just preparatory to launching aërodrome.

of stability is dismissed in eight pages, but this chapter is supplemented by experimental information given at various places elsewhere in the book. The rest of part i. is taken up by the description of the several models constructed and of an overhead launching gear by which they were released; Fig. 1 (a reproduction of plate 12) gives an idea of the thoroughness with which the evolution of each part is described. Elaborate and vivid descriptions of the performance of these models are given in each case, including as a rule a map of the path followed during their flights.

Part ii., written by Mr. C. M. Manly, Dr. Langley's chief assistant—to whom no doubt he would have ascribed a large part of the success had he edited himself the present account of his researches—is solely concerned with the construction and the trials of a man-carrying machine, the two first chapters being devoted to general considerations. The alteration of design necessitated by the change of scale required further experiments with two of the models already described; an account of these is found in chapter iii. A new launching gear, shown in Fig. 2 (a reproduction of plate 43), forms the subject of chapter iv., and the next three chapters deal in an elaborate fashion with the construction of the frame and of the supporting surfaces of the large "aërodrome," and the method of ensuring its equilibrium while in flight.

Two chapters deal with the history of the engines of this machine, and of a quarter-size model of it, which it was intended to try first. This is shown in full flight in Fig. 3 (a reproduction of plate 92). The two last chapters contain the account of the shop and field trials and of the failures—solely caused by some defect in the launching gear—which ended the trials.

An interesting appendix on the flight of the American buzzard ends the book, which should be perused if one wishes to form an adequate idea of the value of the pioneer work done against difficulties of all kinds, conquered by sheer determination to succeed, and only baffled—just as success was at hand—by the lack of financial support due to the antagonism of a hostile Press.

The work is profusely illustrated by more than a hundred plates of a high standard of excellence, including many detail drawings, several maps, and reproductions of photographs; an exhaustive index of twelve pages is not the least commendable feature of this latest and most important addition to the bibliography of aviation.

MAURICE E. J. GHEURY.

FIG. 3.—Quarter-size Model Aërodrome in Flight, August 8, 1903.

THE BESSEMER MEMORIAL GIFT TO THE ROYAL SCHOOL OF MINES.

ON June 29, 1903, on the very day that Lord Rosebery promulgated the scheme for the establishment of an Imperial College in London, a meeting was held at the Mansion House, under the chairmanship of the then Lord Mayor, Sir Marcus Samuel, for the purpose of devising a scheme "to perpetuate the memory of probably one of the greatest men who ever lived"—Sir Henry Bessemer. It was abundantly evident from the speeches delivered on that occasion by the Duke of Norfolk, Lord Haldane, and Sir John Wolfe Barry, that a very serious attempt was being made to establish in the metropolis of the Empire an institution having for its main object the organisation of scientific education with reference to national and imperial industries. Lord Haldane frankly admitted that "it was clear that in our industrial methods we were, in some respects, behind other nations. We possessed magnificent energy, we had a splendid record; but in the application of science to industry we had not hitherto developed anything comparable to those great institutions for technical training in the higher sense, such as exist elsewhere."

It was fitting that the memorial to Bessemer should be established in connection with an institution having aims so definite as the Imperial College, and it was a happy thought to associate the memorial with the Royal School of Mines, then about to undergo reorganisation. Much has occurred since those days. The Scientific development of the Royal School of Mines as a teaching institution is one of the events of the day. Visitors to South Kensington cannot fail to have noticed how largely the accommodation in that school has been increased, and those who have more intimate acquaintance with the internal affairs

of the Imperial College are well aware how considerably the equipment and buildings of the constituent institutions have been supplemented.

On Tuesday, January 30, the Bessemer Memorial Committee formally handed over to the governors of the Imperial College a costly plant for use in the Royal School of Mines. Visitors to the institution on that occasion will have fully realised the relation which this gift must bear to the efficiency of the School of Mines. The laboratory within which the Bessemer gift has been accommodated is one of the numerous extensions now taking place at South Kensington in connection with both the City and Guilds (Engineering) College and the Royal School of Mines. The ore floor of the laboratory, which runs across its east end, is 121 feet long by 30 broad, and is continued as a 12-foot gallery along the south side, and as a 6-foot gallery along the west end. Accommodation is afforded for nine ore bins of 10 tons capacity each, with discharge-gates above the ground floor to fill cars running on a line of track to the elevator. A large dry crushing-room has been provided beneath the ore floor with an elevator passing through it to a sizing-trommel and shaking-screen, another elevator passing up to a line of trommels feeding four jigs on the concentration floor. There is a Blake crusher at the northern end connected by rails from the elevator, rails being also laid along the south gallery to the furnace department at the extreme west.

We have here the complete equipment of the most recent mining and metallurgical plant which has ever been installed in an educational institution. But if this plant were only designed for academic purposes it would scarcely constitute a sufficient memorial to Sir Henry Bessemer. It is gratifying, therefore, to find that in consequence of representations made to the governors by many practising mining engineers and metallurgists, as well as by the Bessemer Memorial Committee itself, the whole instalment of machinery will be placed at the disposal of professional men for private research and investigation. We cannot imagine anything more appropriate as a memorial to Bessemer than this fact, which was announced on the occasion of the donation.

On behalf of the Bessemer Memorial Committee, Colonel Sir Charles Allen formally handed over the equipment to the governing body. In this connection he referred specially to the appropriateness of the memorial, both as regards the particular form it had taken and its association with the Royal School of Mines, and expressed his great satisfaction in that he had been selected by his colleagues, in the absence in Egypt of Sir William Preece, the chairman of the Bessemer Memorial Committee, formally to make the presentation. Sir Charles further stated that as a near relative and an intimate friend of the late Sir Henry Bessemer he felt sure that the memorial could not have taken a form which would have appealed to him more, since he was very specially interested in the educational training of the engineer.

The Right Hon. Gerald W. Balfour, chairman of the executive committee, accepted the gift of the equipment on behalf of the governing body, associating especially those who are members of the committee, and who, in consequence, have been so intimately concerned with the collection of the memorial, in particular Sir William Preece, and also those others who have contributed to the memorial and so enabled the main ideas to be realised. He heard with the greatest possible satisfaction that the committee was not now to be dissolved, but that it hoped to obtain sufficient funds to enable it to maintain the first equipment and keep it in closest touch with industrial requirements, and also to add to and extend it from time to time as is found to be necessary. He understood that as a laboratory and as an equipment it compared most favourably with anything of the same kind in this or any other country, and went on to state that this implied a corresponding obligation on the governing body of the Imperial College to see that it was put to the fullest and best possible use. He hoped that in this respect the Royal School of Mines would justify its former proud record and its present objects as a part of the Imperial College, and would by research and the most advanced scientific work render imperial service to the industries associated with mining and metallurgy.

NOTES.

WE regret to see the announcement of the death, on January 28, of Admiral the Right Hon. Sir John Charles Dalrymple-Hay, Bart., G.C.B., F.R.S., in his ninety-first year.

DR. A. P. LAURIE, principal of the Heriot-Watt College, Edinburgh, has been elected to the professorship of chemistry in the Royal Academy, vacant by the resignation of Sir Arthur Church, K.C.V.O., F.R.S.

THE death is announced, at the age of eighty-nine years, at Schaffhausen, of M. Jacob Amsler, corresponding member of the Paris Academy of Sciences in the section of mechanics since 1892.

ACCORDING to the daily papers, M. Védrines, the French aviator, is, in conjunction with Dr. Charcot, making arrangements to attempt, probably in two years' time, to reach the South Pole by aëroplane.

THE annual meetings of the Institution of Naval Architects will be held on March 27–29 in the hall of the Royal Society of Arts, John Street, Adelphi, London, W.C. The president, the Marquis of Bristol, R.N., will occupy the chair.

THE Paris correspondent of *The Times* states that a committee has been formed at Dôle, the native town of Pasteur on the slopes of the Jura, for the purchase of the house in the Rue des Tanneurs in which this great man of science was born, and that Mr. J. D. Rockefeller has subscribed the remaining 2200*l.* required to purchase the house.

THE Darboux jubilee celebration passed off successfully on January 21. Congratulatory speeches were made by MM. Lippmann, Poincaré, Appell, and others, including the Minister of Public Instruction, after which a commemorative gold medal (by Vernon) was handed over to M. Gaston Darboux. In his reply M. Darboux referred with satisfaction to the present organisation of higher education in France, as compared with what he could remember. Many delegates from foreign societies were present on the occasion.

DR. CHARLES CHILTON, professor of biology at Canterbury College, New Zealand, has been granted leave of absence for 1912, and will spend nearly the whole of the year in Europe visiting the chief biological laboratories and stations. He is at present working at the Marine Laboratory at Plymouth, and is preparing a report on the Amphipoda collected by Dr. Bruce during the voyages of the *Scotia* in Antarctic seas.

AT its annual conversazione this year, the Selborne Society proposes to arrange a Gilbert White exhibition, consisting of relics and manuscripts of the author of the

famous "Natural History of Selborne," with collections illustrating his work and times. The exhibition will be open on February 16 at the conversazione, and to the public on the following day by kind permission of the First Commissioner of his Majesty's Works. It is hoped that all who have objects of interest which should form part of the exhibition will communicate with the honorary secretary of the Selborne Society, at 42 Bloomsbury Square, W.C.

At the end of the current session Sir William Ramsay, K.C.B., F.R.S., will resign the chair of general chemistry in University College, London, to which he was appointed in 1887. At a meeting of the Senate of London University held on January 24, it was resolved:—"That the Senate accept Sir William Ramsay's resignation with sincere regret, and desire to express to him their high appreciation of the services which he has rendered to the University both by his inspiring work as a teacher and by the great series of researches carried out by him at University College during his tenure of the chair of chemistry." It is unnecessary here to refer to Sir William Ramsay's distinguished career, since so recently as January 11 his work was described in our "Scientific Worthies" series by Prof. Wilhelm Ostwald.

On Monday, January 29, Prof. J. Norman Collie, F.R.S., gave to the Royal Geographical Society an account of his recent explorations in the Rocky Mountains to the north of the Yellow Head Pass. In 1910 he and Mr. A. L. Munn utilised the new branch of the Canadian Pacific Railway by Edmonton to explore the valley of the Smoky River and the mountain region which it traverses. All existing maps of the region are both incomplete and inaccurate, and the information gained in 1910 encouraged the explorers in 1911 to utilise the routes which they had found, and to study more thoroughly the region traversed in the preceding year. Magnificent glaciers, vast snowfields, and range upon range of snow peaks were seen; the main watershed was determined over many miles of the range, and topographical questions of interest were investigated. Series of parallel ranges with transverse valley complicate the drainage, which at some points is indeterminate, flowing at one point to the Atlantic in 1909, and by a new channel in a shingle flat to the Pacific in 1910. Both to the mountaineer and to the student of mountain structure this region, now being rendered accessible by railway, offers problems of the greatest interest.

We regret to record that the distinguished surgeon, Sir Henry Trentham Butlin, Bart., died on January 24, at the age of sixty-six. He was elected president of the Royal College of Surgeons of England in 1910, and again in 1911, but to the regret of all found it necessary to resign that honour only a few weeks ago on account of his health. His investigations and clinical observations helped to improve many branches of practical surgery, but his chief services to medicine were rendered as an ardent supporter and leader of every movement directed towards the improvement of medical education and of medical research. He was himself a keen student of cancer, regarding that disease as parasitic in nature, and took a most active part in the management of the Cancer Research Fund. During the years he was dean of the medical faculty of the University of London he led a strenuous movement which sought to concentrate the teaching of medical subjects in a teaching university worthy of London. He was president of the British Medical Association when that body held its great meeting in London in 1910. His great public services to medicine were recognised last year, when he was created a Baronet. Sir Henry Butlin was a pupil of Sir James Paget, and held the memory of that great surgeon in the highest esteem.

We announced last week with regret the premature death of M. Théophile Durand, director of the Jardin Botanique de l'État at Brussels, who, after a prolonged illness, which assumed a serious aspect about six weeks ago, passed away on Friday, January 12. He was born at Saint-Josse-ten-Noode, a suburb of Brussels, on September 4, 1855. In 1880 he entered the Botanic Garden at Brussels, then under the directorship of F. Crépin, and he remained intimately connected with that establishment to the last. He was appointed "Conservateur au Jardin Botanique" in 1880 and director in 1902, succeeding F. Crépin. He was more a bibliographer and compiler than a man of original research, but within those limits he was very active and successful. In most of his publications he shared the authorship with a collaborator, probably an unavoidable consequence of his very defective eyesight; but he is solely responsible for the "Index Generum Phanerogamarum," which appeared in 1888, and for the "Introduction" and the third volume (Phanerogames) of the "Prodrome de la Flore Belge," by Durand and De Wildemann. With the latter he also published a volume of "Illustrations de la flore du Congo," and another of "Contributions à la flore du Congo"; further, "Plantae Thonnerianae Congolenses," "Reliquiae Dewevrianae," and a "Matériaux pour la flore du Congo"; with Schinz, a "Conspectus Florae Africae," of which, however, only vol. i., part i., and vol. v. appeared, and "Études sur la flore de l'état indépendant du Congo"; with his daughter Hélène, a "Sylloge florae Congolanae" (Phanerogamae); with Pittier, a "Primitiae Florae Costaricensis," since continued by Pittier; and with B. D. Jackson the first supplement to the "Index Kewensis." T. Durand was a corresponding member of the Belgian Academy, a Chevalier de l'Ordre de Léopold, and Officier de l'Ordre de la Couronne. He was for some time president of the Geographical Society of Belgium, and general secretary of the Botanical Society of Belgium, and in 1910 he acted as one of the presidents of the International Botanical Congress, held at Brussels.

An extension of the Horniman Museum, comprising a lecture hall and a new library, the gift of Mr. Emslie J. Horniman, was opened to the public on January 27 by Sir Archibald Geikie, K.C.B., president of the Royal Society. The library is a students' reference library of books on anthropology, zoology and botany, and other works of assistance to biological workers. In declaring the building open, Sir Archibald Geikie said that the old idea that a museum is a miscellaneous collection of oddities has passed away. Museums are now to be found in every town of consequence, and they are as much an essential part of a town's organisation as an art gallery or public library. One great necessity in starting a museum is to begin on scientific lines. The Horniman Museum has been arranged on such lines, which give the ordinary man in the street a clear notion of the relations of different animals and the various functions which they perform. One good feature is the excellent labels affixed to the specimens. A good label is just about as essential as the object to which it is affixed.

A circular letter from the Research Defence Society reminds us that it is just four years since the society was founded, to make generally known the facts as to experiments on animals in this country, and the regulations under which they are conducted, the immense importance of such

experiments to the welfare of mankind, and the great saving of human and animal life and health which is already due to them. During the past year the society gained 1000 new members and associates, and formed ten new branches. It now has 5000 members and associates. The following pamphlets and leaflets have been published during the year:—(1) "A Question of Ethics"; (2) "Experiments during 1910"; (3) "The Facts of the Case"; (4) "The Saving of Human Lives"; (5) "The Rockefeller Institute"; (6) "The Case presented by Antivivisectionists"; (7) "Recent Surgical Progress"; (8) "Antivivisection Shops"; (9) "Tuberculosis"; (10) "Sleeping Sickness"; (11) "Annual Report, Balance Sheet, and List of Members and Associates." A book is in the press giving a full *résumé* of the evidence before the Royal Commission; it will be published within a few weeks after the publication of the final report of the Royal Commission. It is hoped that many readers of NATURE will become members or associates of the society, and will help its useful work. The honorary secretary, Mr. Stephen Paget, 21 Ladbroke Square, London, W., will be glad to answer every inquiry, to send literature to applicants for it, to receive names for membership or associateship, and to make necessary arrangements for addresses and lantern-lectures in London or elsewhere.

IN the January issue of *The Quarterly Review* Sir E. im Thurn describes the social and economical condition of the Crown Colony of Fiji, with special reference to the question of imported labour. He concludes that the British islands in the western Pacific, with a few negligible exceptions already annexed to the Dominions of Australia and New Zealand, form one growing Crown Colony, widely isolated from all others, and lying adjacent to these great Dominions. There are, he believes, good reasons why these islands should not be immediately annexed to either of these Dominions. But it is time that efforts should be made to advance their growth and development, so that they may be fitted ultimately to join the future United Dominion of Australasia, which is destined to represent the British Empire in the western Pacific.

THE Journal of the Gypsy Lore Society commences in part ii., vol. v., the publication of an important sociological report on the Gypsy problem, being a State paper compiled in 1900 by Mr. A. Tresleff, secretary of the committee appointed in Finland to consider the laws and relations of the Government with these people. Mr. Tresleff, provided with recommendations from the Czar, visited many parts of Europe and made personal inquiries into the condition of these nomads and the legislation affecting them. The question, one of no ordinary difficulty, is discussed by a capable and impartial official, and will be of much value to all who are interested in the problem. The Journal has done good service by bringing it, in a translation prepared under the writer's supervision, before the British public.

IN the January issue of *Man* Mr. C. W. Hobley describes a remarkable collection of protective charms obtained from an old elephant hunter at Ukamba, British East Africa. Various kinds of powder eaten before a hunting expedition make the sportsman's aim straight; another is a whip, which on such occasions is cracked seven times "for good luck"; and two twigs bound together, if bitten after mentioning the animal which the hunter wishes to capture, secure success, and are also useful in winning a suit in the court of the Elders. Another charm is used when a new village is being founded; if the owner walks with it round the proposed site, no beasts of prey will pass the charmed circle. The trade of manufacturing these charms must be profitable, as their price ranges from Rs. 35 and five goats for the magic powder down to smaller numbers of these animals for the cheaper varieties.

WE have on several previous occasions made allusion to the valuable work issued from the medical radiographic department of Guy's Hospital, in which, by the X-ray method after a bismuth meal, kinks and similar disorders in the intestinal tube can be detected. The most recent of these papers, from the pen of Dr. A. C. Jordan (Proc. Roy. Soc. Med., 1911, vol. v., p. 9), deals with the subject more fully, and is illustrated by a number of excellent skiagrams. The intestinal stasis produced by kinks leads to a well-recognised chronic illness, which makes life unendurable. It can be remedied by a radical cure spoken of as "short circuiting." This consists in dividing the lower end of the small intestine and attaching it to the rectum. The cases recorded show most gratifying results.

To the Transactions of the Buchan Club for 1910–11 Mr. W. Taylor contributes a list of the cetaceans recorded during the last forty years on the east coast of Scotland.

THE exhibition illustrating the animals, plants, and minerals mentioned in the Bible, which was opened last summer at the Natural History Museum, has been so much appreciated by the public that it is to be maintained for some time longer. A new edition of the guide-book to this exhibition contains certain emendations on the original text.

SOME interesting particulars with regard to the distribution of the minute aquatic crustaceans of the genus Apus in eastern Asia are recorded by Messrs. H. J. Walton and S. Kemp in the Records of the Indian Museum of December, 1911 (vol. vi., part 5). Sporadic instances of the occurrence of representatives of the genus have been recorded previously in the Himalaya near the sources of the Sutlej, in Baluchistan, in the salt lakes of the Tibet plateau, and in China. The new records add the Bulandshahr district of the United Provinces of India and the Banihal district of Jamu, lying to the south of the main Himalayan axis, to the range of the genus. The specimens from both these areas, all of which were females, appear referable to the European *A. cancriformis*. In the Jamu district these crustaceans are asserted to be injurious to newly sprouting rice, but, as Mr. Kemp observes, this indictment requires investigation.

CONSIDERABLE economic importance attaches to the announcement by Dr. J. Stafford, in the January number of *The American Naturalist*, that he has discovered the later stages of the free-swimming larva of the Canadian oyster, which had long formed a gap in the developmental history of these molluscs. It is now shown that the larvæ continue to exist as such in the neighbourhood of the oyster-beds for two or three weeks longer than was previously known to be the case before they finally settle down as spat at an age of three or four weeks after fertilisation. The late larvæ were taken in plankton-nets, and for the future can readily be recognised. This will render it practicable to determine the exact date at which "cultch" should be laid down for the reception of the spat. From his own observations Dr. Stafford is led to believe that cultivation of the Canadian Atlantic oyster (*Ostrea virginica*) in the Pacific would prove profitable. The author has discovered that the British Columbia *O. lurida* differs from the Canadian and resembles the European species in being hermaphrodite.

The chief result recorded in a paper—received as a reprint from *The Journal of Agricultural Science* (vol. iv., part ii.)—on "silver-leaf" disease, by Mr. F. T. Brooks, is the confirmation of the accepted view that this symptom, especially prevalent in the case of plum trees, is caused by the fungus *Stereum purpureum*. Mention is made of the observation of the same pathological appearance on sycamore, horse chestnut, Spiræa, and other trees.

In his report for the year 1910–11 as director of the Royal Botanic Gardens, Ceylon, Dr. C. J. Willis takes leave of the post which he has occupied for fifteen years, not less to the great benefit of the agricultural interests in the island than to his personal distinction. Owing to the activities of the various assistants associated with him, the gardens have become recognised as an important centre of research, and in recent years a notable stream of distinguished botanists has taken advantage of the research facilities offered. During the year under review there has been a vigorous output of the Annals and Circulars, in which the papers by Mr. T. Petch have been prominent.

In *The Journal of Genetics* (vol. i., No. 4) there is published a paper on the inheritance of doubleness and other characters in stocks, in which Miss E. R. Saunders follows up her previous conclusions. Having obtained the results that certain single races of stocks produce only single flowers, while others, eversporting, produce doubles and singles, and that the pollen grains apparently all carry doubleness, while the ovules carry in some cases double, in other cases single characters, it is now shown that the sulphur-white, a double-throwing race, is also eversporting in regard to plastid colour. Further, the two phenomena are curiously bound up, as the singles are all white, while the doubles are mostly cream, but a few are also white. These are the premises for which the author elaborates an explanatory hypothesis capable of being tested by further experiment. An appended note gives support to the belief that stock seeds destined to give rise to double flowers are proportionally more vigorous in growth than the single quality.

One of the most useful of the publications of the Board of Agriculture is its Journal, containing articles of general agricultural interest, and published monthly at the extremely low price of fourpence. Among recent articles may be mentioned one by Mr. H. C. Long on the identification and eradication of some common weeds, a subject on which the agriculturist still has much to learn. Dr. Raeder describes how small holdings for agricultural labourers are created in Denmark, the method being either to make State contributions to societies established for this purpose, or to advance loans direct to the labourers themselves. Although the small holder enjoys full right of ownership, the common law has been modified in some respects. The holding must always be used for agricultural purposes, and the stock must always be kept up and maintained in good condition. Certain privileges are forfeited if the holding is sold or sublet. The large majority of small holders are labourers, and on an average they work for wages during 155 days of the year.

In *Petermann's Mitteilungen* for January, E. Banse discusses the central idea of geography, and would mark out geographical regions so that the interaction of all factors within each should aid in completing the picture of the region. He shows in a map how the present artificial divisions of continents might be more logically treated from a geographical point of view.

In the *Zeitschrift für Vermessungswesen* for 1911 Prof. Hammer discusses the relation of pace-length to stature, and deals exhaustively with the data furnished by 368 students. He obtains 76 cm. as the ordinary pace-length, corresponding to a height of 1·60 metres, and 91 cm. for a height of 1·90 metres, the mean value of the whole series being 83½ cm. for a height of 1·73 metres. He refers also to certain experiments on German soldiers, which seem to indicate a distinct lengthening of the ordinary pace as a result of military training.

Mr. J. E. Spafford, of Jerusalem, communicates to *The Geographical Journal* for January a short account of a circumnavigation of the Dead Sea made by motor-boat in June last. Brief descriptions of the shores and various places on them are given, but no special observations of any kind were made. Some excellent photographs of different parts of the shore are given, and especially two illustrating the gorge of the Arnon River. An indication of the present tendency towards a more quantitative and precise treatment of geography is the paper in the same number, by Mr. B. C. Wallis, on the importance of precise description, aided by figures. He deprecates the use of indefinite expressions, and would use percentages and ratios derived from statistics spread over five-year or longer periods. The necessity for this is true not only for economic geography, but for other branches, and in many cases in advanced work the degree of accuracy might often be stated with advantage.

Himmel und Erde for January contains an excellent paper on seismographs and their records, by Dr. C. Mainka, of Strassburg. A summary is given of the many different modifications of the horizontal pendulum, with a detailed account of the author's bifilar pendulum. Of the few records which illustrate the paper, the most interesting is that of the Messina earthquake of 1908, furnished by the Mainka pendulum.

The Austrian Geological Survey has also recently published (*Abhandlungen*, vol. xvi., part iii.) a memoir by Dr. Marian Salopek on the Triassic Cephalopoda of southern Dalmatia and Montenegro. Most of the new species and varieties are unfortunately represented only by a single specimen, but the descriptions and beautiful figures will be useful for comparison with corresponding fossils which are now being studied from Albania, Greece, and Asia Minor.

A simple form of recording filament electrometer is described by M. P. Villard in the December, 1911, number of *Le Radium*. The U-shaped carbon filament is that of a 110-volt 5 or 10-candle lamp, according to the sensitiveness required. It is supported horizontally midway between two small vertical plates of metal, the distance apart of which can be varied. They are connected to the poles of a dry pile, and the filament is attracted to one or the other, according to the potential to which it is charged. The motion is recorded photographically on a revolving drum by means of the light from an electric lamp reflected into a microscope objective by a small cylindrical mirror attached to the end of the filament. The motion is nearly aperiodic, the zero absolutely stable, and variations of frequency not exceeding 5 per second are correctly recorded.

In an article in *The Oxford and Cambridge Review* for January, Mr. H. S. Shelton urges on the writers of text-books on heat the necessity of stating the law of "dissipation" or "degradation" of energy in a less general form than it takes, for example, in Poynting and Thomson's

"Heat." He sees "no ground whatever" for extending it from terrestrial to cosmic processes, and characterises it as a "scientific dogma" current at the present day because "any careful and systematic study of the principles of scientific method is considered unnecessary on the part of those who seek to solve physical problems." We should like to assure Mr. Shelton that the application of the law to molecular processes and to their interaction with the æther has received, and is receiving, the attention of physicists, who can deal with it without offence to the principles of scientific method. Whether their discussions are suitable for students' text-books is very doubtful.

SPECIAL interest attaches to a paper on the phthalylhydrazides, by Messrs. Chattaway and Wünsch, in the Chemical Society's Journal, on account of the fact that the authors have succeeded in preparing measurable crystals of the two varieties of a number of the compounds of this series; their crystalline properties have been examined by Mr. T. V. Barker, who has contributed to the paper complete data and drawings in the case of eight of the modifications. The occurrence of the two varieties is usually determined mainly by temperature, and the authors are therefore inclined to regard them as merely polymorphic. In this they agree with the conclusions arrived at by Piutti and Abati in reference to the substituted phthalimides, which exhibit a similar dimorphism. Later workers on the phthalimides have preferred to regard the two varieties as isomeric. The evidence in favour of this view is here very strong, because one of the varieties of the imides is colourless and the other yellow, and it is almost impossible to believe that the yellow colour could be produced by any process of remarshalling the colourless molecules. In the case of the hydrazides, the difference of colour is less striking, but, as the authors point out, the possibility of isomerism is one that must not be overlooked.

IT has long been known that depth of water on measured miles is a serious factor in determining speed results, and an article in *The Engineer* for January 26 gives prominence to recent investigations on this subject. Following experiments which have been made in this country on the Maplin and on the Skelmorlie measured miles, the first-mentioned having a depth of 45 feet and the second a depth of 240 feet, the United States Navy authorities have run trials with a battleship (the *Michigan*) and with two torpedo-boat destroyers (the *Flusser* and the *Reid*) over their three measured distances. The results show clearly the increase in power due to shallow depth, and it is probable that the two shallower courses will be discarded in future for high-speed trials, new courses being laid down.

THE first presidential address in the twelve years' history of the Society of Model and Experimental Engineers was delivered by Mr. Percival Marshall on January 22, the subject being "Model Engineering: Past, Present, and Future." That models have played a very important part in the development of real engineering practice is well known to those acquainted with the work of Newcomen, Watt, Murdock, Nasmyth, and other early pioneers. Probably the most striking example of service rendered by a model is to be found in Watt's invention of the separate condenser, devised while repairing the Newcomen model belonging to Glasgow University. Since these times the art of model-making has been practised continuously, not only by those professionally engaged, but also by others whose tastes have led them to seek recreation in mechanical pursuits. Exhibitions have been very instrumental in stimulating interest in model-making, and the large and valuable collection at the South Kensington Museum has had great influence, both as an educational factor and in promoting interest in models. Models are now used by hundreds of firms to demonstrate the merits or principles of their manufactures, and are invaluable in the educational work of technical colleges. Models of inventions are also extensively employed, one firm specialising in this class of work turning out some 2500 models every year. Fully twenty thousand metal-turning lathes have been sold during the last seven years by the various firms who cater for amateur workers. The president urged that museums equipped with models representing the chief manufactures should be set up in large towns; these would be very valuable in the education of the rising generation, and would be a source of reference and stimulation for those with inventive minds.

A SECOND edition of Mr. C. T. Millis's "Technical Arithmetic and Geometry" has been published by Messrs. Methuen and Co., Ltd. The new edition has been revised; decimals now receive treatment before vulgar fractions are studied, and notes on factors, multiples, and drawing-office work have been added.

A SEVENTH edition, revised by Prof. F. W. Gamble, F.R.S., of "A Junior Course of Practical Zoology," by the late Prof. A. Milnes Marshall and the late Dr. C. H. Hurst, has been published by Messrs. Smith, Elder and Co. In this edition a new chapter, dealing with the chick, has been added to meet the needs of those who attempt elementary embryology in their junior course. The price of the volume is 10*s*. 6*d*.

MESSRS. CONSTABLE AND CO., LTD., will commence the publication, in April next, of a new quarterly scientific review to be entitled *Bedrock*, "a quarterly review of scientific thought." The editorial committee consists of Sir Bryan Donkin, Prof. E. B. Poulton, F.R.S., Prof. H. H. Turner, F.R.S., and Mr. G. Archdall Reid. The acting editor will be Mr. H. B. Grylls. The first number will contain the following amongst other contributions:—Value of a logic of method, Prof. J. Welton; recent researches on alcoholism, G. Archdall Reid; Darwin and Bergson as interpreters of evolution, Prof. E. W. Poulton; social and sexual evolution, the hermit of Prague; notes on current research; the interaction of passing ships, Prof. A. H. Gibson.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR FEBRUARY:—

Feb. 1. 1h. 36m. Neptune in conjunction with the Moon (Neptune 5° 39′ S.).
3. 8h. 0m. Saturn at quadrature to the Sun.
6. 17h. 54m. Mercury in conjunction with Uranus (Mercury 0° 55′ S.).
11. 9h. 21m. Jupiter in conjunction with the Moon (Jupiter 4° 37′ N.).
14. 10h. 30m. Venus in conjunction with the Moon (Venus 5° 44′ N.).
15. 9h. 21m. Uranus in conjunction with the Moon (Uranus 4° 36′ N.).
23. 20h. 28m. Saturn in conjunction with the Moon (Saturn 4° 23′ S.).
24. 9h. 29m. Venus in conjunction with Uranus (Venus 0° 39′ N.).
25. 15h. 32m. Mars in conjunction with the Moon (Mars 1° 43′ S.).
26. 7h. 0m. Venus in the descending node.
28. 10h. 5m. Neptune in conjunction with the Moon (Neptune 5° 46′ S.).

MARS AND SATURN.—M. Jarry-Desloges reports (*Astronomische Nachrichten*, No. 4549) that the southern white polar cap on Mars appears to be reforming, particularly on Thyle I., and that the insular area which he reported to the west of Novissima Thyle is still apparent, and forms a background to the dark, sharply defined M. Australe.

On Saturn he has remarked many changes in the southern regions. The dark polar cap has not been seen again, but the pole is occupied by a bright area surrounded by a very thin dark band; three other bands were also seen on the disc.

SEARCH-EPHEMERIDES FOR WESTPHAL'S COMET, 1852 IV.—The period for Westphal's 1852 comet is rather uncertain, but, according to a new calculation by Dr. Adolf Hnatek, which is published in No. 4549 of the *Astronomische Nachrichten*, it is not unlikely that perihelion will be reached in October of this year.

This is on the basis that the period is sixty years, but Dr. Hnatek gives search-ephemerides, for the first half of this year, taking 60·0, 60·1, 60·2, 60·3, 60·4, 60·5, 61·0, 61·5, and 62·0 years as the period; for the first six values the computed brightness, on June 19, would lie between magnitudes 7·5 and 10·0, but until later in the year the comet is considerably south of the equator.

OBSERVATIONS OF JUPITER'S GALILEAN SATELLITES.—In Circular No. 12 of the Transvaal Observatory, Mr. Innes records a large number of eclipses, transits, &c., of the four Galilean satellites of Jupiter, and gives some interesting notes concerning the more uncommon phenomena observed. On April 4, 1911, a partial transit of J. III. was observed, and Mr. Innes remarks that the possibility of a partial transit does not appear to have been recognised hitherto. A table is given showing the differences between the observed times and those computed by Dr. de Sitter, those given in the "Nautical Almanac," and those computed from Prof. Sampson's tables; the differences range between −0·6 and −12·5 minutes. Peculiar shapes of the satellites and their shadows, *e.g.* the shape of a figure 8, were noted during several transits, and on May 24, 1911, before the commencement of the ingress of a transit by J. III., a bright spot, with a dark band skirting it on the south side, was seen in the N.*f.* quadrant of the satellite.

STAR CALENDARS, CHARTS, AND GUIDES.—From the publishers we have received copies of the H.P.H. series of annuals. The "Star Calendar" for 1912 is an improvement on that of former years, and has the aperture, which enables the star chart on the under card to be seen, oval instead of circular; the price is 1*s*. net. The "Star Almanac," 6*d*. net, is, as in previous years, intended to display on the observatory or study wall, and it contains a large amount of useful information. A number of notes discuss the æther, the corona, &c., and in addition to four circular star charts there are reproductions of Father Cortie's 1905 corona and Max Wolf's photograph of the North America nebula. The above are published by Messrs. Simpkin, Marshall and Co., Ltd.

In "Stars and Constellations: a Little Guide to the Sky," Miss Agnes Fry describes the constellations and their relative positions, &c., in rhyme. For the instruction of young people the work will probably prove useful, and may be obtained from the publishers, Messrs. Baker and Son, Clifton, price 6*d*. net.

RECENT EARTHQUAKES.

SEVERAL shocks, supposed to be due to earthquakes, were felt in this country towards the end of last week. On January 26, at 4 a.m., a shock was felt at Dunblane strong enough to awaken sleepers, but not strong enough to affect the Milne seismograph at the Royal Observatory, Edinburgh. On January 28, at about 3.35 a.m., a tremor was felt in Glenfruin, a valley lying between the Gareloch and Loch Lomond. Early in the morning of January 26 there were three distinct shocks in the colliery district of Llanhilleth, in Monmouthshire, strong enough to make the miners leave their work. On January 20, shortly before 2 a.m., a sharp tremor was felt at Lennoxtown and Campsie, in Stirlingshire, again without affecting the Edinburgh seismograph. Of the four disturbances, the first two were apparently of seismic origin. Dunblane lies close to the district on the south side of the Ochil Hills, where so many earthquakes have resulted during the last twelve years from slips of the great fault which forms the southern boundary of the hills. The Glenfruin shock seems to be a successor of two other earthquakes in the same part of Scotland—the Dunoon earthquakes of September 18, 1904, and July 3, 1908. The Llanhilleth and Lennoxtown shocks bear a close resemblance to those which are often felt in colliery districts, and which are probably caused by small fault-slips precipitated by the working in the mines.

A severe earthquake occurred at 6 p.m. on January 24 in the island of Cephalonia, which, with the neighbouring islands of Zante and Santa Maura, forms one of the most important seismic zones in Europe. Buildings in Argostoli, the capital, were injured; considerable damage was caused in the villages at the southern end of the island, as well as in the island of Zante. The villages in the north-east of Cephalonia seem to have suffered most. Altogether, five villages are reported as destroyed and eight persons as killed. Though hundreds of shocks have been felt in the district during the last twenty years, the earthquake of January 24 is apparently the most severe since the disastrous Zante earthquakes of January 31 and April 17, 1893.

The director of the Meteorological Office reports that on January 25 he received a telegram from the superintendent of the Eskdale Observatory, in Dumfriesshire, as follows:—"Fine earthquake 24th at 16½ hours 3000 km. S.E." More exact measurements of the records have given the epicentre as 2570 kilometres distant, 56° 34′ E. of S., that is, at lat. 39° 16′ N., long. 21° 53′ E. The position of the earthquake is thus placed in S.W. Thessaly, near the border between Turkey and Greece, so that the Eskdale record would appear to have been derived from the earthquake in Cephalonia referred to above.

A NEW SYSTEM OF GUN SIGHTING.

THE new Remington negative angle system of sighting, which formed the subject of a lecture by Sir George Greenhill, F.R.S., to the Junior Institution of Engineers on Friday, January 19, is the invention of Mr. H. Ommundsen, worked out and applied to military and sporting rifles in collaboration with Mr. E. Newitt. The invention has for its object the elimination of the necessity for judging distance in sport and war by making use of the visual angle which proceeds from the shooter's eye and embraces the object aimed at. By inverting the back-sight, making it so that the object can be seen under it instead of over, as at present, the object can be callipered visually between the fore- and back-sight. The magnitude of the visual angle varies inversely with distance, and the further off the object is the smaller will be the visual angle, and consequently the higher the foresight has to be raised in order to calliper the object, the result being a suitable automatic increase of elevation. This automatic variation of elevation may be obtained simply by selecting a point of aim at a predetermined depth below the objective. This predetermined depth creates a visual angle, which varies in precisely the same way as above described, and being below the objective the angle automatically subtracts from the fixed angle of elevation on the rifle, and is thus called the "negative angle." The fixed angle of elevation on the rifle is calculated beforehand to give appropriate results within limits which depend upon the power of the cartridge. Applied to sporting rifles, the negative angle sight gives astonishing results. With the comparatively old 0·303 deer-stalking rifle, or with, say, the 0·400 big-game rifle, animals can be shot through the heart at any distance between, say, 30 and 230 yards, without in any way altering the aim or adjusting the sight. Some tests have been carried out by the Remington Arms-U.M.C. Company, of New York and London, who have acquired the whole patent rights. In the military tests the skirmishing results bounded up from less than 20 per cent. under the old style of sights to 95 under the negative angle method. On "stag" targets with the ordinary 0·303 sporting rifle, 7-inch "heart" groups were made with unfailing regularity at varying distances between 50 and 250 yards.

GLACIERS IN SOUTHERN NORWAY.

IN the second part of *Bergens Museums Aarbok* for 1911, J. Rekstad publishes in German a description of the glacier region of southern Norway, accompanied by thirty-four illustrations. The paper is intended to serve as a guide to visitors, and does not discuss questions of glacial erosion or the origin of landscape-forms. The Jostedalsbræ (Fig. 1) north of the Sognefjord has a surface of 855 square kilometres, and furnishes an excellent type of the plateau-snowfield, from which glaciers fall, rather than creep, into the valleys round about. As one views a high field of this kind from a distance, the contrast with the limited snow-basins of the Alps is immediately apparent. Round about it, isolated glaciers lie in cirques, which have been no doubt carved out since the time when the main ice spread farther over hill and dale.

FIG. 1.—The Jostedalsbræ, showing the snow-plateau.

Regenerated glaciers occur at the feet of steep places on the plateau ridge, and one of these, the Suphellebræ, extends down to a level of 50 metres above the sea. The author directs attention to its banded structure, which here must be attributed to flow under pressure, since any such structure due to successive deposition of snow on the névé-field would be obliterated as the ice falls over the rock-face (Fig. 2). The terminal block-moraines of the Böium Glacier are referred to, and are so well marked as to have deserved a photograph.

As a glacier retreats, its valley may become filled up by detritus washed out by the water from the melting ice. An alluvial flat arises, over which the streams meander, frequently changing their courses, and these streams have no relation to the magnitude of the original valley. When the ice finally passes away, under warmer climatic conditions, the streams may almost disappear. Where ice-erosion has been powerful, dry valleys filled by alluvium may remain, in the formation of which water has played very little part. This consideration is suggested by the view of the Tunsberg valley (Fig. 3), stretching from the foot of the longest glacier in Norway, one of the tongues from the east side of the massive Jostedalsbræ. The author records (p. 26) that the rate of infilling in these valleys is so rapid that vegetation does not gather on the stones, and that dwellings have to be shifted, owing to the rise of glacial waters on the growing alluvial floor. The cattle-paths must similarly be moved upwards on the valley-sides. The retreat of the glaciers during the last 150 years has left smooth steep rocks exposed in many cases, the scenes of former ice-cascades, and the

FIG. 2.—The Suphellebræ, a regenerated glacier on the margin of the Jostedalsbræ.

valley-glaciers will probably shrink back to the edge of the high field whence they came.

In the lower part of the Lodal Glacier (p. 30), the moraine material comes to light in consequence of melting of the surface, and the stones, as happens in ordinary glacier-tables, protect the ice beneath them. The linear moraines thus run on walls of ice, which increase in height towards the glacier-foot.

FIG. 3.—The Tunsberg Valley, from the termination of the Tunsberg Glacier.

FIG. 4.—The Mjölkevoldsbræ descending from the plateau of the Jostedalsbræ.

Leaving the Jostedalsbræ, the author proceeds to consider a number of small glaciers, mostly of the Alpine type, and then deals with the Hardangerjökel, a plateau-glacier of almost circular form, south of Finse, on the new Christiania and Bergen line. The term *jökel* is applied to firn and glacier-masses, equally with the more familiar *brae*. The Rembesdalsbræ, a tongue from this plateau, has dammed a stream so as to form the Dæmmevatn, a lake which at one time endangered the Simadal below. An artificial tunnel in the rock now carries off its water when the level rises unduly high.

The Folgefonn, or Folgefond—in "fonn" we have yet another word for a firn-mass giving rise to glaciers—lies to the east of the Hardangerfjord, and gives rise to the Buarbræ, often visited by travellers from Odde. This glacier has begun to advance during the last six years (p. 49).

The precipitation that feeds these plateau-snowfields of Norway is greater near the coast than in the interior. The snow-line in the southern part of the country lies at 1200 metres above the sea on the west, and rises eastward to 1900 metres.

In connection with J. Rekstad's descriptive work, a paper by Fritz Machaček may well be referred to, entitled "Geomorphologische Studien aus dem norwegischen Hochgebirge" (*Abhandl. der k.k. geographischen Gesellschaft in Wien*, Bd. vii., 1908, Nummer 2). Dr. Machaček shows how the general form of southern Norway is that of a dissected plateau, on which snowfields rest here and there.

The mountain-crests are not grouped along parallel chains. The glacier-fields on the plateaus are from 300 to 400 metres thick, a fact that must be taken into account when the height of the plateau itself is estimated (p. 13).

Machaček very naturally sets aside Richter's suggestion that the plateaus have been formed by the working back of cirques and the union of their floors, and he sees in them the remains of a pre-Glacial peneplane, which was already formed by the close of Mesozoic times, and which was invaded in the Christiania district by the Upper Cretaceous sea. Traces of a second peneplane are found on the valley-sides, so that the uplift to the present level occurred in at least two stages. The author discusses the forms produced by glacial erosion, and attributes the steepness of the valley-heads (p. 52) to the concentration of the ice descending from the plateaus, and a consequent almost vertical erosion at these points.

This paper is illustrated by ten exceptionally fine photographs, which are, however, not discussed in detail as geographical examples in the text. G. A. J. C.

THE STARFISHES OF THE NORTH PACIFIC.[1]

THE prolific nature of the Pacific fauna is well shown by this intensive study of the starfish. The region covered by this report includes all the waters north of a line drawn from the southern end of Sakhalin to the southern boundary of the United States; and when this vast area is examined, the north-east Pacific portion of it turns out to be not only the most fertile section, but, as regards starfishes, the most prolific in species and individuals of any portion of the world. Even though the deep-water forms are little known, ninety-six species (of the twenty-three families under consideration) are described and figured, and another bulletin is promised in which the remaining large super-family Forcipulata (including the genus Asterias) is to be described. The descriptions are based upon a large, often a very large, amount of material, and include minute descriptions of the external features, together with other anatomical characters. The compilation of such a work has involved a vast amount of labour extending over several years, and the result is a monograph of value to every museum. A full estimate of the work can only be made when the complementary volume is published.

Henricia leviuscula. Specimen from Puget Sound.

Perhaps the most interesting points in what appears at first sight to be a forbidding list of systematic descriptions lie in the distribution and variation of certain genera. Of the ninety-six species here described, seventy-three are confined to the North Pacific, twelve occur in the North Atlantic also, whilst the remainder form part of another and southern fauna ranging down the west coast of South America. The dozen species common to the two great oceans include such well-known forms as *Solaster endeca*, *S. papposa*, and *Henricia sanguinolenta*. These are, speaking generally, circumpolar forms, and they include species which exhibit a baffling, and as yet little analysed, form of variation. Upon this subject we cannot do better than quote the judicial remarks of the author:—"The study of this collection of Henricia has strongly suggested the possibility that all the species of a genus are connected by intergrades, not serially, but by numerous often anastomosing lines" (p. 270). "So great and so numerous are the variations in most of the species that each is to be regarded more as a centre of variation, deviations from the type proceeding in many directions till they meet and often merge with aberrant members of nearly related forms" (p. 269). "A system of nomenclature perfected for a rather limited set of animals (the higher vertebrates) may not so well meet the requirements of a different class of creatures . . . . which have been subjected to more modifying factors" (p. 270).

The whole work is, from this point of view, simply an unconscious comment upon the need for rigorous experimental analysis of the genetics of this group. We only wish that Dr. Fisher, who knows these animals so well, had imparted a more life-like aspect to the delineation of their characters. The very curious parasite figured on Plate iii. (said to be an Ascothoracid [Cirripede] parasite) is the only mention of an intrusive body we have discovered. There must be a great mass of interesting bionomical information about Pacific Asteroidea, and it is to be hoped that Dr. Fisher will publish it in his next volume. Perhaps the most generally useful part of the present one lies in the "keys" for determining both genera and species and in the valuable plates with which the volume is so generously provided.

[1] Smithsonian Institution, United States National Museum, Bulletin 76 Asteroidea of the North Pacific and Adjacent Waters, by Prof. W. K. Fisher. Part 1., Phanerozonia and Spinulosa, pp. vi+419+122 plates (Washington: Government Printing Office, 1911.)

SOME RECENT FISH LITERATURE.

TO No. 5 of the Leland Stanford Junior University Publications Mr. E. A. Starks contributes three articles on the osteology of certain scomberoid fishes, the first dealing with the genus Leiognathus, the second with the families Gempylidæ, Lepidopidæ, and Trichiuridæ, and the third with the horse-mackerels (Carangidæ). In regard to Leiognathus, it may be mentioned that the genus was transferred by Mr. Boulenger from the scomberoid group to a position in the neighbourhood of the percoids in the family Gerridæ; but this view is disputed by the author, who regards the genus as the type of a scomberoid family.

At the conclusion of an article on the breeding of the eel, published in the September number of *Himmel und Erde*, Mr. Carl Müller states that we are still in ignorance with regard to the age of the youngest Leptocephalus larva at present known, namely, specimens of about 7 cm. in length, it being uncertain whether these are six or eighteen months old. Of younger larvæ and the eggs nothing is yet known, and we are equally ignorant as to the interval which elapses between the arrival of eels in the sea and their spawning. Neither is it known what becomes of eels subsequent to spawning; possibly they die soon after this event, although it is equally possible that they may live for a considerable period. All that is definitely known on this point is that after having once entered the sea they never return to fresh water.

To *The Field* of September 23 (vol. cxviii.) Mr. Boulenger contributed an article on the eels of Africa, in which it was pointed out that, although our knowledge is still imperfect, there appear to be four species, of which the one inhabiting North Africa (and likewise Madeira and the Canaries) is identical with the European *Anguilla vulgaris*.

In East and South Africa are found *A. mossambica*, *A. bengalensis*, and *A. bicolor*, the range of all of which extends to the South Pacific. Of these, *A. mossambica*, ranging from the Cape to Zanzibar and the Seychelles, comes nearest to the European species, from which it differs by the broader bands of teeth. Strange to say, however, there are no eels in tropical West Africa, this being accounted for by "Dr. J. Schmidt, of the Danish Fishery Commission, who, with the aid of Danish hydrographers, has ascertained that the water of the great depths of the inter-tropical Atlantic is for the greater part between 4° and 5° C., nowhere reaching the temperature ascertained to be the minimum (7° at a depth of 1000 metres) required for the breeding of the eel in the North Atlantic. Therefore the reason why eels are absent from some of the warmest regions of the world, such as West Africa and tropical South America, is that the deep sea to which they would have to resort for breeding is too cold, an extraordinary fact when we bear in mind that, outside the period of reproduction and of larval life, the European eel can accommodate itself to such varied climatic conditions as obtain between the Arctic circle and Nubia. The suitable conditions for breeding are only to be found in the North Atlantic, the Mediterranean, and the Indian Ocean; in consequence eels are only found in those parts of Africa (North, East, South) which are within the migratory powers of the fish."

In this connection may be quoted a paragraph recently published in the daily Press, that, in order, apparently, to preserve the supply for home waters, "Denmark intends to stop the migration of eels from the Baltic to the outer ocean by placing a barrier of submerged electric lights between the island of Faröe and the Fyen coast. Eels, which migrate in the dark, will not, it is believed, cross this barrier."

An article on the migration of fishes, including eels, by Mr. V. Franz, appears in the aforesaid issue of *Himmel und Erde*.

A summary of reports relative to eel-fry, drawn up by Mr. A. B. E. Hillas, is published in No. ii. of Irish Fisheries Investigations for 1909 (1911); while No. vi. of the same for 1910 is devoted to an account, by Messrs. Holt and Byrne, of the fishes of the genus Scopelus from the Irish Atlantic slope.

PAPERS ON PLANT PHYSIOLOGY.

THE action of radium compounds on plants is discussed by Prof. H. Molisch in a short article published in the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxx., part v.). Experiments showed that sufficient light is emitted by strong preparations to produce heliotropic curvature in the case of very susceptible plants such as the oat and the common vetch. With regard to the action of the α, β, and γ rays, it was found that longitudinal growth is diminished and that the periods of spontaneous nutation are shortened, but they induce no form of tropism.

Prof. J. v. Wiesner contributes to the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxx., part iii.), a paper, supplementary to his book, discussing further investigations as to the light-regulated position of leaves and the amount of light utilised by plants (Lichtgenuss). In the same publication experiments are described by Dr. F. Weber which were intended to throw light on the dormant condition of trees and shrubs. Following up the warm-bath method of forcing proposed by Molisch, which showed that individual branches can be separately resuscitated, the effect of injecting water into branches was tried, and also of the mere insertion of the injection syringe. In the case of lilac and the broad-leaved lime, water injection caused the buds to open three weeks earlier than normal buds, while mere pricking produced a similar result, though not quite so pronounced.

With reference to experiments designed to investigate the effect of growing plants in air enriched with carbon dioxide, Dr. F. F. Blackman communicates a note to *The Gardener's Chronicle* (December 2, 1911) in which he presents an apt illustration of the operations of "limiting factors." When plants are placed in air which contains more than the normal amount of carbon dioxide, if either the light or the temperature is low, the plant may not respond to the increased supply of carbon dioxide, because assimilation is as great as the amount of light or degree of heat will allow; the light or temperature may act as a limiting factor. If the light is increased, then plant assimilation may also increase until another limiting factor comes into operation. Therefore in experiments dealing with assimilation, growth-rate, or other physiological processes it is necessary to consider whether the results expected from improvements of any one condition may not be prevented by the limitation imposed by another factor.

An account of cotton investigations in Egypt, by Mr. W. L. Balls, published in *The Cairo Scientific Journal* (vol. v., No. 60), deals with several interesting problems in general plant physiology. The conclusions, based on the study of the root system of the cotton plant, deserve close attention. While examining the effect of temperature upon growth, it was observed that growth of the tap root amounted to half a metre in twenty-four days at a mean temperature of 25° C. Considerable importance is attached to checks imposed upon root growth, whether by interference of other roots or rise of the water-table. It is argued, and experiments are cited in proof, that a premature rise of the water-table, as in 1909, must cause untimely shedding of bolls, flowers, and buds. Reference is also made to the previously noted "sunshine effect," *i.e.* the complete arrest of main-stem growth during the hottest months whenever the sun shines directly on the plant.

A contribution to the subject of saltmarsh and estuarine vegetation, which deals with the distribution of halophytic plants as controlled by the salinity of the subsoil water, is presented by Dr. J. W. Harshberger in the Proceedings of the American Philosophical Society, Philadelphia (vol. i., No. 201). A combined hydrometer and thermometer was used for determining the water density at various stations, where the assemblage of plants was also noted. From the readings taken, maximum and minimum densities were obtained for each plant. Thus *Spartina stricta*, var. *maritima*, which showed the widest range of accommodation, was found growing in water containing as little as 2 and as much as 4 per cent. of salt. For *Spartina patens* and *Salicornia herbacea* a similar maximum, but a higher minimum, are recorded. *Distichlis spicata*, *Limonium carolinianum*, and *Juncus Gerardi*, which follow next in order, have a much narrower range. A remarkably low maximum is recorded for *Suaeda maritima*.

In connection with the condition of apples appropriately known as "bitter pit," which has supplied fungologists and others with a puzzling problem, an explanation ascribing the cause to poisonous effects produced by arsenical sprays has been put forward in the Proceedings of the Royal Society of Victoria (vol. xxiv., part i.) by Dr. Jean White; the arguments are rational, and if substantiated will lead to a more careful consideration of spray effects. The author had had the opportunity of making a few trials with sprayed and unsprayed trees which bear out the explanation, but the opinion is expressed reservedly and published in order to induce fruit-growers to put the theory to test.

A PHOTOGRAPHIC STUDY OF VORTEX RINGS IN LIQUIDS.

THOUGH the laws of vortex motion have been extensively examined by the ablest mathematicians, comparatively few experiments appear to have been made to study the nature of these motions in air and liquids beyond some experiments made about 1867 by Prof. P. G. Tait, who examined the properties of smoke rings in air. In an extended experimental investigation of this subject the present writer found that very beautiful vortex motions may be easily produced in such high-density fluids as water and oils which have free surfaces and small viscosity. The study consisted in examining the various properties of single and double rings, both visually and with the aid of the camera.

A tank was constructed which would permit the rings to be observed from the two sides, the top, and one end. This tank was made with sides of plate glass. It was 151 cm. long, 59·5 cm. high, and 12 cm. wide. For the production of the rings a cylindrical metal can was pro-

vided. The diameter of the can was 7·7 cm., and its axial length 6·6 cm. One end of this was provided with a flexible diaphragm of phosphor bronze, which could be struck suddenly by the plunger of an electromagnet. The other end of the can could be closed with metal discs, which were provided with one or more holes of various shapes and dimensions. For the production of a single ring one hole in the centre of a disc was used 1 cm. in diameter, and for the production of double rings two holes, one above the other, each 0·85 cm., were employed. We shall hereafter call this can the "gun."

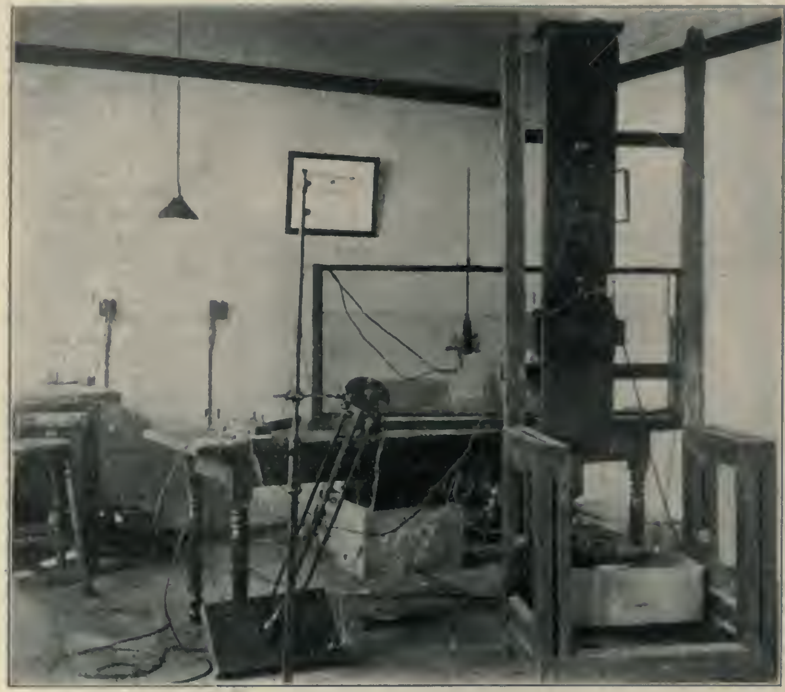


FIG. 1.—Apparatus for the production and photography of vortex rings.

To make the rings visible, and at the same time provide for keeping the water clear so that the tank would not have to be repeatedly refilled, it was necessary to fill the can with highly coloured water, the colouring of which would entirely disappear when the ring broke up and dissipated. Among other colouring materials tried in the experiments, that which was most used was phenol phthaline. The water in the can was made strongly alkaline, and the water in the tank was made slightly acid. Thus the projected rings were of a deep red colour, and entirely disappeared upon breaking up. An illustration is here reproduced (Fig. 1) of the entire outfit above described, together with the plate drop and other devices employed in the photographing of the rings.

Experiments preliminary to the photographic work revealed the following properties of these rings. The motion through the water is rapid, being about 2 metres per second. The rings move in a straight path with a gradually diminishing speed, and always maintain their plane perpendicular to their line of motion. When the water of the tank contains suspended particles of slightly greater density than water, a ring will pass through and among them without incorporating and carrying any of the particles along with it. When a piece of chiffon cloth is stretched over a frame and is held in the path of a ring, the ring will be found to pass easily through it without being broken up or much disturbed in its motion. When a piece of tissue paper similarly stretched on a frame is held in the path of the ring, the ring will break through it, though it is in turn broken up by the impact. If a light watch-chain hangs in the water and is fairly struck by a ring it is bent into a decided curve by the force of the blow. The kinetic energy of these rings is thus seen to be considerable. When two rings are made to approach from opposite ends of the tank, they will on impacting be broken up and dissipated if they meet fairly, but if their line of approach

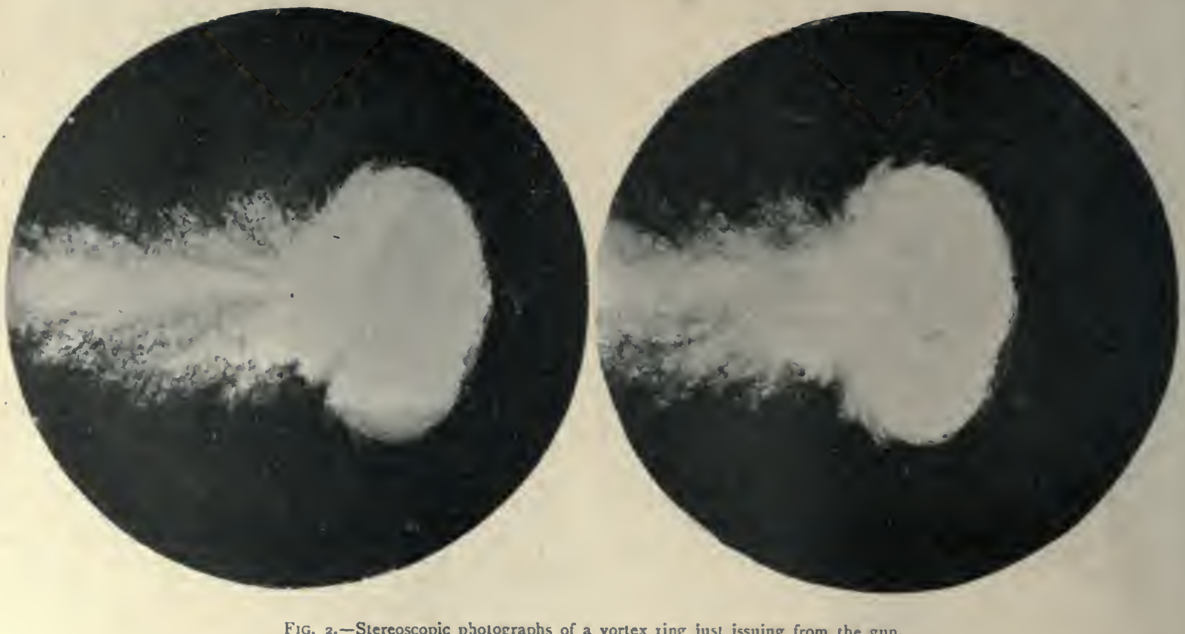


FIG. 2.—Stereoscopic photographs of a vortex ring just issuing from the gun.

is such that they might be expected to touch on their edges, upon a close approach they bend out of a straight course and pass one another without an encounter.

When a ring is aimed to approach the surface of the water, it is upon reaching the surface reflected in a very beautiful manner. As the surface of the water is approached the upper edge of the ring gains velocity over the lower edge, the plane of the ring tilting in such a manner as to maintain itself always at right angles to the line of motion of the ring. If the angle between the surface of the water and the line of approach of the ring to the surface be as much as 22°, the ring is still reflected. If this angle is much exceeded the ring bursts through the surface with a spurt of water.

Refraction was also observed. The lower half of the tank was filled with a dense salt solution, and the upper half with pure water. The ring in passing from the upper to the lower layer, with a slight angle from the horizontal, was deviated from its straight path. The laws of both reflection and refraction were proved to be, approximately at least, those of light.

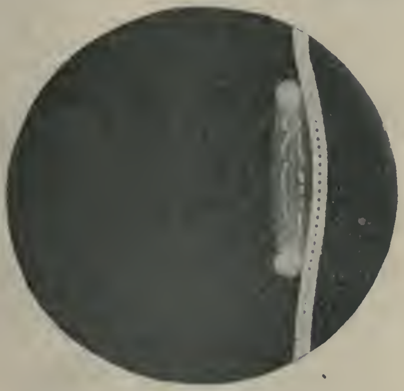


FIG. 4.—Vortex ring about to strike a watch-chain after progressing about half a metre from the gun.

Rings ejected from a very exactly circular hole are themselves circular, and advance through the water with no other motion visible than that of progression. If, on the other hand, the hole is elliptical, they have a vibratory motion in their own plane. The vibrations are such that the vortex changes from an ellipse with its major axis vertical to an ellipse with this axis horizontal. The vibrations are almost too rapid to be followed distinctly with the eye, but make an interesting sight when the ring is observed from the end of the tank as it approaches the eye.

FIG. 3.—Stereoscopic view of a fully-formed vortex ring.

The most scientifically interesting property of water rings may be observed when the end of the gun is provided with two holes, one above the other. In the experiments tried, the two holes, each 0·85 cm. in diameter, were placed with their centres separated 2·55 cm. The two rings, which issue simultaneously from the two holes, begin to attract each other the moment they leave the gun, and at a distance from the gun of about 6 to 8 cm. they come together with great suddenness, uniting to form a single ring of approximately twice the circumference of one of them. The rings so formed proceed with the same velocity as a single ring until broken up by impact with the end or side of the tank. This ring possesses vibratory motions that are remarkable. Unlike the single ring, which issues from an elliptical hole with vibrations in one plane only, a ring which is formed by the union of two rings has a very complicated vibratory motion in planes both normal and parallel to the direction of forward motion of the rings. These motions will be better understood by a study of the photographic views.

If the surface of the water in the tank be covered with a layer of kerosene oil from 5 to 10 cm. deep, an interesting phenomenon may be observed, which is rendered more apparent when the oil is coloured a deep red with a dye known to the trade as Soudan III. When the gun is filled with uncoloured water, and is located a few centimetres below the surface of the oil, and an invisible ring is projected at a suitable angle with the surface of the oil, it enters the oil, and is instantly converted into an oil ring which proceeds to the upper surface of the oil; it is there reflected and re-enters the water as a visible oil ring, which proceeds with only slightly diminished velocity for a metre or more through the water. After the ring breaks up the oil rises to the surface of the water, and after the surface has been quitted another ring may be produced, and the process may be continued indefinitely. As the water is uncoloured, the illusion is produced of red oil rings issuing from the oil without any apparent agency for their production.

Experiments were conducted which demonstrated that in the case of two liquids of different densities—at least if these two liquids are not miscible—it is possible to project

a ring of the less dense liquid through the liquid of greater density, but it is not possible to project a vortex ring of the liquid of greater density through the liquid of less density. Thus a ring of kerosene oil can be projected through water, but a ring of carbon tetrachloride cannot. By projecting rings of liquid paraffin through hot water,

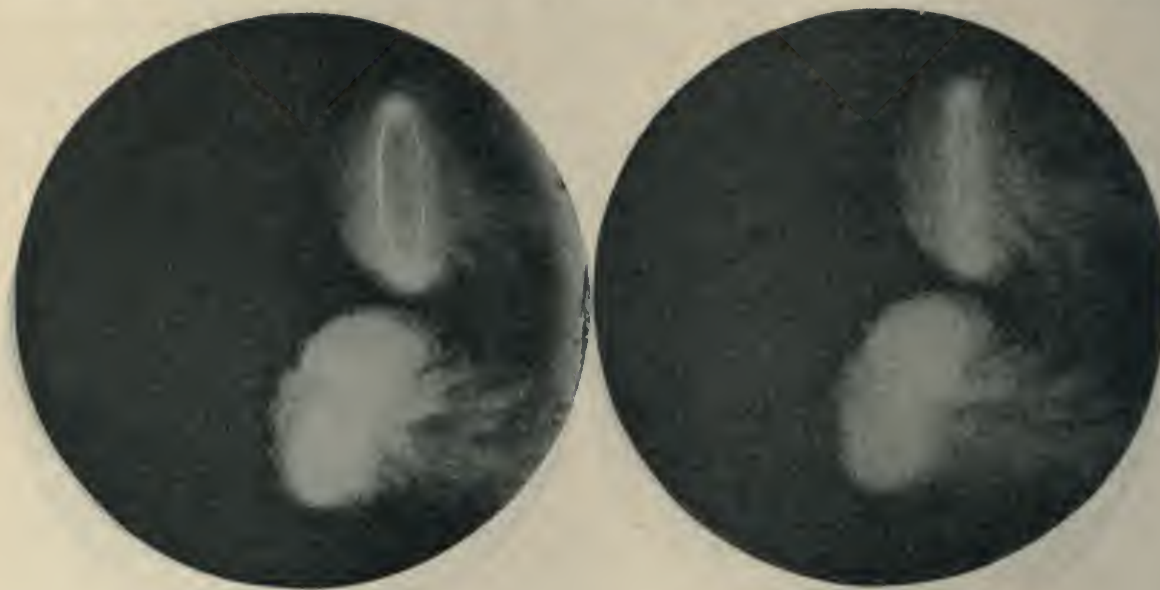


FIG. 5.—Stereoscopic view of two vortex rings produced simultaneously.

and thence into an underneath stratum of cold water, very pretty solid rings of paraffin were obtained and preserved.

The problem of photographing these rings was one of peculiar difficulty. The rapidity of their motions made it necessary to make exposures which would be of the order of only one twenty-five-thousandth of a second. Of course,

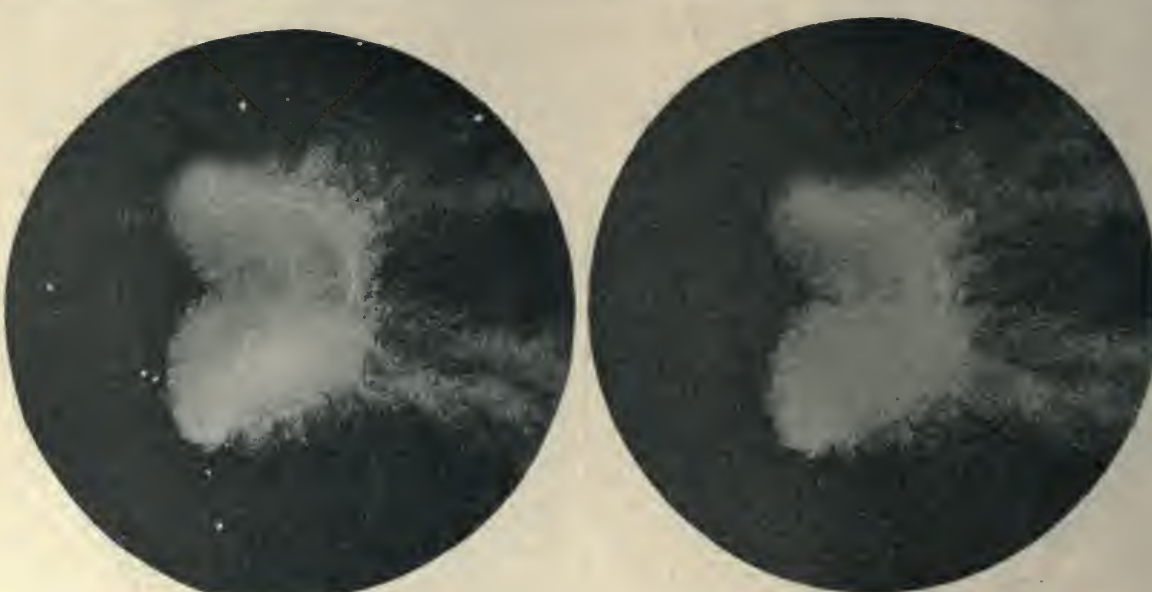


FIG. 6.—Stereoscopic view of two vortex rings uniting.

no mechanical shutter could be constructed to give so brief an exposure. An electric spark method, an optical arrangement, and a timing device were finally devised which gave excellent results and fully exposed plates. The majority of the pictures were obtained with a stereoscopic camera, and the double views which were obtained, when examined, as they should be, with a stereoscope, reveal the mechanism of the rings in a much finer manner than can be obtained from single views. The electrical spark device employed was very similar to the primary spark used in the sending station for wireless telegraphy. The stereo-optic device required that two sparks, separated in space by a distance equivalent to that between the lenses of the stereoscopic camera, should be simultaneously produced. A very special form of double spark-gap was constructed so that the sparks took place between amalgamated zinc terminals and the clean, bright surface of mercury.

At the moment when the ring was photographed it appeared before the brilliantly illuminated surface of a plano-convex lens 12½ cm. in diameter. The ring as seen in the camera thus appeared as a dark object against a brilliantly illuminated background. The alternating

current used produced a succession of sparks, each lasting a less time, perhaps, than the fifty-thousandth of a second,

FIG. 7.—Three photographs, separated by about one-fiftieth of a second, of a vibrating vortex ring formed by the union of two rings.

one, and only one, spark occurring at each alternation of the primary current, or about eighty per second.

Three events were made, by the timing device, to occur simultaneously; they were the arrival of the falling plate at the back of the camera, the arrival of the ring in the field of view, and the occurrence of a spark, or, more precisely, of a brilliant flash of light. The timing was all done by a falling weight, which made suitably timed electrical contacts, one of which operated an electromagnet to release the plate, and another the electromagnet of the vortex ring gun.

When a single ring first issues from the gun it is not recognisable as a ring, but is surrounded by an ellipsoid of coloured water, and is followed by a trail of colour. This is shown in the stereoscopic view in Fig. 2. As the ring progresses, the colouring of this ellipsoid, in which the ring is embedded, and the colouring of the trail, grows paler and paler until the ring in the interior of the ellipsoid alone is visible, and has the appearance shown in the steroscopic view in Fig. 3. Fig. 4, which is of special interest on account of the fortunate timing, shows a ring which has already progressed half a metre or more, and is just about to strike a silver watch-chain which hangs suspended in the water. It should be noted that the chain has begun to bend before an actual impact has occurred. This, together with the other views, demonstrates that the ring is at all times surrounded with an ellipsoid of water which moves with the ring, and in its early stages is visible as shown in Fig. 2. Water being a viscous fluid, the material of this ellipsoid is gradually being drained off and left behind as the trail, but also being as continuously replenished with clear water, until it is invisible except by its effects, which are made manifest in Fig. 4.

The stereoscopic view in Fig. 5 shows two rings which have just issued simultaneously from two holes in the gun. They are perhaps 5 or 6 cm. from the gun, and are already seen to be approaching each other under the influence of their mutual attraction. In the stereoscopic view in Fig. 6 two single rings have just united. A careful study of this picture in a stereoscope will show just what has taken place. Already the conditions are fully established for the subsequent complicated vibratory motions of this type of ring. The single view in Fig. 7 shows another ring at a later stage, also made up of two separate rings, as it appears in three successive stages separated by intervals of about one-fiftieth of a second. Here is plainly seen the four types of motion possessed by liquid vortices formed by the union of two single rings. First, there is a rotation about the vortex filament; secondly, the forward motion of the vortex as a whole; thirdly, the motion of oscillation of the extremities of the vertical diameter of the vortex in a vertical plane lying parallel to the direction of forward motion; and, fourthly, a motion of oscillation of the extremities of the horizontal diameter of the vortex in a horizontal plane. These four motions, except the second, are too rapid to be observed satisfactorily with the eye.

FIG. 8.—Stereoscopic view of a vibratory ring in one phase of its motion.

A slightly enlarged stereoscopic view of one of these vibratory rings in one phase of its motions is shown in Fig. 8. In this view, as also in Figs. 3 and 4, note the line of particles lying in the filimentary axis of the ring. These particles probably consist of materials less dense than water which have been gathered up by the ring in its progress through the water, not entirely free from suspended matter, and swept into the axis and carried along with the ring.

The results of the research above outlined were first described in the September and October numbers (1911) of the Journal of the Franklin Institute. In the original paper are given other photographs than those reproduced here, and the apparatus is described in sufficient detail to enable one to reproduce it. The electric circuits and other devices employed in taking the pictures are fully described, and physical explanations of the vortex motions observed are given. It is there shown that most, if not all, of the observed motions of liquid vortices may be approximately explained by employing the principle first laid down by Bernoulli, that since the sum of the potential and kinetic energies in a liquid is constant, it results that where the velocity of the fluid is high the hydrostatic pressure is diminished. The attraction and final union of two rings is supposed to be explained by this principle.

It is hoped that this experimental study of actual vortex motions in fluids having viscosity will throw light upon and constitute a proper basis for mathematical investigations regarding ideal fluids.

EDWIN F. NORTHRUP.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The governing body of Gonville and Caius College has resolved to place in the hands of the University Association for transference to the university the sum of 500*l*., to be invested for the maintenance of buildings. It hopes that the sum will be added to the fund now being collected for the maintenance of the new buildings for physiology and experimental psychology.

Dr. Macalister, professor of anatomy, and Dr. Haddon have been nominated to represent the university at the International Congress of Americanists to be held in London in May next, and Prof. Burkitt has been chosen to represent the university at an International Congress on the History of Religion to be held at Leyden in September next.

FOUR Gresham lectures on "Sleeping Sickness" will be delivered on February 13, 14, 15, and 16 by Dr. F. M. Sandwith, Gresham professor of physic. The lectures, which will be delivered at the City of London School, Victoria Embankment, E.C., are free to the public, and will begin each evening at six o'clock.

IT is announced in *The Times* that Dr. Francis, honorary secretary of the Education Fund for Europeans and Eurasians in India, has been promised by an anonymous donor a lakh of rupees (about 6600*l*.) if four lakhs more are raised in India. Between 80,000*l*. and 90,000*l*. of the 250,000*l*. needed has already been raised in this country, and it is hoped that the recent impetus given to native education in India will also direct attention to the urgent need of those whom the fund will benefit.

THE Goldsmiths' Company has made the following grants to the Senate of the University of London:—for the building fund of King's College for Women, 10,000*l*.; for the endowment fund of Bedford College for Women, 5000*l*.; for the building and equipment fund of the chemical department of University College, Gower Street, 1000*l*. The company has also made a grant of 1000*l*. to the National Physical Laboratory at Teddington for the equipment of the metallurgical department at that institution.

THE Education Committee of the London County Council has published some interesting particulars as to the number and ages of pupils in London secondary schools receiving financial aid from the Council. During the year ended on March 31 last there were in such schools 14,036 pupils—9369 boys and 4667 girls. Of this total there were 112 boys and 31 girls above eighteen years of age; 618 boys and 402 girls between sixteen and eighteen years; and 2820 boys and 1435 girls between fourteen and sixteen years. That is to say, less than half of the pupils in these secondary schools, which include many of the best in London, are above fourteen years of age, and 941, it may be added, are below ten years of age.

THE Central Bureau for the Employment of Women, of 5 Prince's Street, Cavendish Square, London, W., has published a pamphlet entitled "Openings for University Women other than Teaching." The booklet contains a summary of professions suitable for women of higher education, suggestions on more recent spheres of remunerative labour, and a comparative table of university degrees and diplomas in the British Isles. Miss M. G. Spencer, the secretary of the Central Bureau, may be congratulated upon the success which has followed her attempt in the pamphlet to provide a bird's-eye view of the field now open to educated women who desire to take part in the world's work. The particulars as to courses of training, and the information as to probable salaries in various appointments, should be of assistance to parents arranging for the education of their girls.

IN the issue of *Science* for January 5 Prof. Rudolf Tombo, jun., of Columbia University, gives his annual analysis of the registration statistics of American universities. A decrease in the total enrolment for the current session was noticeable at Chicago, Missouri, Northwestern, Texas, and Yale Universities. This year only four institutions exhibit an increase of above 200 students, as against seven in 1910 and eleven in 1909. According to the figures for 1910, twenty-seven universities ranked as follows as regards number of students:—Columbia, Chicago, Michigan, Harvard, Pennsylvania, Cornell, Minnesota, California, Wisconsin, Illinois, New York University, Nebraska, Northwestern, Yale, Syracuse, Ohio State, Missouri, Texas, Kansas, Indiana, Tulane, Iowa, Stanford, Princeton, Western Reserve, Johns Hopkins, Virginia. Comparing this with the order for 1911, we find that Columbia, with 8642 students, continues to maintain its long lead, that California has passed from the eighth to the second place, that Cornell has passed from the sixth to the third place, that Michigan and Harvard have each dropped down one place, Pennsylvania two places, and Chicago four, and that Wisconsin and Illinois have advanced a place.

THE Birmingham Education Committee has decided to recommend the City Council to make a grant annually to the University equal to the net produce of a penny rate, which is estimated to realise about 16,000*l*. It has also recommended that the University should offer annually fifteen major scholarships entitling the holders to a remission of fees, together with a maintenance grant in case of necessity of not more than 30*l*. per annum, and should appoint certain additional lecturers. It may be noted that as a consequence of the grant of an extra halfpenny rate (making a penny rate in all) made by the City Council last year, before the extension of the city boundaries, twelve city scholarships were offered for competition, the successful candidates being entitled to maintenance grants of an annual value not exceeding 30*l*. each if their circumstances were such as to render pecuniary aid of this kind desirable. Nine of these scholarships have been awarded, and six of the holders are receiving maintenance grants (five at 30*l*. per annum and one at 25*l*.). The Workers' Educational Association has hitherto received valuable support from the University, and members of the University staff have given their services gratuitously. The Birmingham Education Committee now suggests that such services should receive formal recognition, and presumably appropriate remuneration, which the increase in value of the grant in consequence of the enlargement of the city should render possible.

IT is expected that the Rice Institute at Houston, Texas, U.S.A., will be opened for the reception of students next autumn. The institute is described as being "of liberal and technical learning founded by William Marsh Rice, and dedicated by him to the advancement of Letters, Science, and Art." An artistically illustrated prospectus of this latest American institute has reached us, which shows

that the late Mr. W. M. Rice, who was for many years a resident in Houston, left a large sum of money, which after reduction by litigation still reached 2,000,000*l*., to endow and equip the institute. President Lovett, who is in charge of the new institution, came from Princeton University, and spent a year visiting seats of learning throughout the world, so as to enable him to advise the trustees as to the character the buildings and work of the new institute might with advantage take. The result is that the first of the palatial buildings are now almost complete, and will form the nucleus of what will eventually be a much more extensive suite of halls and residences. For the present no upper limit will be assigned to the work of the institute, and the lower limit will be that of the more conservative of American universities. The initial teaching staff is to be organised for university work in science and letters, and it is intended to build up a school of pure and applied science of the highest grade. Men and women will be admitted, and there will be no charge for tuition. Rooms in the residential hall and board will be provided at actual cost price. It is interesting to record that the corner-stone of the administration building was laid last year on the seventy-fifth anniversary of the date when Texas declared its independence of Mexico. For the first few years this building will be used to meet some of the needs of instruction. The first building in the students' residential group for men has been begun, and the mechanical laboratory, machine shop, and power house are being erected north of the administration building.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 25.—Sir Archibald Geikie, K.C.B. president, in the chair.—Prof. J. S. **Townsend**: Determination of the coefficient of interdiffusion of gases and the velocity of ions under an electric force, in terms of the mean free paths. A method is described by which an expression for the rate of interdiffusion of gases may be easily found, either on the ordinary supposition that the effect of a collision makes all subsequent directions of motion of the molecules equally probable, or without specifying in any way the effect of a collision. Similar expressions are found for the velocity of ions under electric forces. In all cases the rate of diffusion of the ions is of the form $K=\frac{1}{3}LV$, and the velocity under the electric force $u=\frac{Xe}{m}\cdot\frac{L}{V}$. L does not, in general, represent the mean free path, but it has the same meaning in both expressions, so that when an ion is moving under the action of a force and also by the process of diffusion its velocity is given by the equation

$$u=\frac{-K}{n}\frac{dn}{dx}+\frac{Xe}{m}\cdot\frac{L}{V},$$

or

$$\frac{\frac{1}{3}mnV^2u}{K}=-\frac{mV^2}{3}\frac{dn}{dx}+Xen,$$

or

$$\frac{1}{K}(pu)=-\frac{dp}{dx}+nXe,$$

which is the well-known form to which Maxwell's equation reduces when external electric forces are acting. The general equations for the motion of ions may thus be easily found from the rate of diffusion and the velocity under an electric force when these quantities are correctly determined.—Dr. H. **Geiger**: Note on the scattering of α particles. In a previous paper experiments were described on the scattering of the α particles by foils of various materials and thicknesses. The present note deals with a theoretical examination of the question. The scattering is considered as the result of a multitude of small deflections of the α particle by the individual atoms of the matter traversed. The experimental curve of distribution with angle for a scattered pencil of α particles is found to be in good agreement with that derived from simple probability theory. The deductions also explain the experimental result that for thin foils, which do not appreciably alter the velocity of the α particles, the most probable angle of scattering varies as the square root of the thickness. To find the variation of the most probable scattering angle for large thicknesses of matter traversed, the change in velocity of the α particles has to be taken into account. Assuming, as found by experiment, that the most probable angle of scattering is inversely proportional to the third power of the speed, the theoretical curve is found to give a satisfactory explanation of the experimental results obtained with thick foils.—A. S. **Russell**: The effect of temperature upon radio-active disintegration. The effect of temperature upon the rate of decay, and the amount of β and γ-ray activity, of radium emanation, of active deposit, and of radium C has been investigated. The results are entirely negative. All abnormalities of activity of β rays obtained by previous authors, and by the author in this research, may be completely explained on two simple grounds. The first of these is a change of distribution of radium C caused by its partial volatilisation inside the quartz tube at temperatures greater than 320°. The second is a change in the partition of radium C between the walls of the quartz envelope and the space enclosed. At room temperature the greater part of the radium C is usually on the walls. At room temperature, after the tube has been cooled suddenly from high temperatures, it is entirely on the walls. Above 650° the radium C is distributed homogeneously throughout the volume of the tube. Each of these partitions gives a different β-ray ionisation in an electroscope, because the average path of the rays through the walls of the quartz envelope depends upon the partition. Under the conditions of experiment, radium B and radium C, and very probably radium A, may be completely volatilised inside sealed quartz tubes at a temperature of 650°. Radium B commences to volatilise at room temperature.—F. W. **Aston** and H. E. **Watson**: The relation between current, voltage, pressure, and the length of the dark space in different gases. In a previous paper one of the authors has shown that in the discharge between large plane aluminium electrodes in gases at various pressures the following empirical equations are approximately true:—

$$D=\frac{A}{P}+\frac{B}{\sqrt{c}},\ V=E+\frac{F\sqrt{c}}{P}$$

where D is the length of the dark space, V the voltage between the negative glow and the kathode, c the current density, P the pressure, and A, B, E, F constants depending on the nature of the gas. The first part of the present communication gives the results of the continuation of this work, with the values of the constants for hydrogen, nitrogen, air oxygen, carbon monoxide, helium, and argon. The second part deals with a systematic investigation into the behaviour of the inactive gases when in a pure state. It was found that these gases behaved in an anomalous manner, and by no means satisfied the above equations in general, but gave values in better agreement with a third equation obtained by eliminating P from the two above. The results are described for helium, neon, argon, krypton, and xenon. Peculiar interest attaches to these gases in that all of them exhibit to a more or less striking degree the primary dark space recently discovered by one of the authors in hydrogen and helium. The behaviour of helium was exceedingly erratic, and seemed to indicate that this gas could support the discharge in two entirely different ways.—Dr. A. O. **Rankine**: The viscosities of gaseous chlorine and bromine. By means of a method resembling in some respects that described by the author in earlier communications, the viscosities of chlorine and bromine have been compared with that of air. From these ratios the absolute values are deduced. The viscosities of chlorine having been obtained at two temperatures, it has been possible to calculate Sutherland's constant. The various values are as follows:—

Gas.	Temperature.	Viscosity in C.G.S.
Chlorine	12·7° C.	$1{\cdot}297\times10^{-4}$
Chlorine	99·1° C.	$1{\cdot}688\times10^{-4}$
Bromine	98·7° C.	$1{\cdot}869\times10^{-4}$

The value of Sutherland's constant for chlorine is

$$C=325.$$

The ratio of the critical temperature of chlorine (416° abs.) to this constant is 1·28, which is somewhat higher than the constant value (1·14) of the corresponding ratio for

most gases; but this might be accounted for by the uncertainty of the exact value of C, arising from the smallness of the temperature range. If the values of the viscosity of chlorine and bromine at *corresponding* temperatures are calculated, it is found that the squares of the viscosities are proportional to the respective atomic weights. (Corresponding temperatures signify those which bear equal ratios to the respective critical temperatures.) In this respect chlorine and bromine appear to conform with the same rule as has been shown to hold for the inert gases.—Dr. P. E. **Shaw**: The testing of plane surfaces. Scraped and lapped plane surfaces are found not only in surface plates supplied by the engineering trade, but also in several apparatus of precision, *e.g.* interferometers and measuring machines. It is quite possible that the errors of these surfaces may be the determining factor in the accuracy of the measurement made in using these apparatus. Yet up to the present there seems to have been no simple device for measuring these errors. To supply this want, two forms of surface-tester have been made by the writer:—(*a*) A stout wooden bar, 16 inches long, has twin feet half-inch apart at one end, whilst there is a third foot at the far end. Midway between the twin feet at one end and the third foot at the other is a micrometer screw. The instrument acts on the spherometer principle, but contact is made electrically with a telephone in circuit. (*b*) A steel bar, 12 inches long, has one foot quarter-inch diameter at one end and a similar foot at the other end, whilst midway between the feet is the end of a micrometer screw. Contact is generally made mechanically. This instrument must be made very carefully, the flat surfaces of the two feet and of the micrometer end being in one position truly in one plane. (*b*) is made in duplicate, so that by using first one tester and then the other on one place of a surface, and then "fitting" them together, the actual departure of the surface from planeness can be found. These testers read to 1/10,000 inch, and have an error on one reading of about that amount. Investigations have been made on a considerable number of "surface plates" and "straight edges" as supplied by the engineering trade. A bad plate shows errors of about 1/2000 inch from true plane, an average one only 1/5000 inch, and some special ones of small size, recently made, had a figure of only 1/10,000 as indicated by tester (*b*). Tests were also made by these instruments on many samples of plate-glass, for which the errors varied from 1/3000 inch to 1/300 inch on a length of 12 inches. Thus we have a means of revealing a surface out of truth, whether due to faulty making or to warping with lapse of time.—Captain A. D. **Fraser** and Dr. H. L. **Duke**: Antelope infected with *Trypanosoma gambiense*. (1) Antelope may remain in apparently perfect health for a year after having been infected with a human strain of *T. gambiense*. (2) One antelope was still capable of infecting clean laboratory-bred *Glossina palpalis* 315 days after it had been infected. (3) A small quantity of blood taken from one antelope 327 days after its infection was proved by inoculation into a white rat to be infective. (4) As the interval after the infection of the antelope increases, their infectivity, as tested by "cycle" transmission experiments, dissection of flies which have fed upon them, and by the injection of the buck's blood into susceptible animals, appears to diminish. (5) A duiker was infected with a human strain of *Trypanosoma gambiense* by feeding infected *Glossina palpalis* upon it.

Geological Society, January 10.—Prof. W. W. Watts, F.R.S., president, in the chair.—S. H. **Warren**: A late glacial stage in the valley of the river Lea, subsequent to the epoch of River-drift man. With reports on the flowering plants, by F. J. **Lewis**; on the mosses, by H. N. **Dixon**; on the Mollusca, by A. S. **Kennard** and B. B. **Woodward**; on the Coleoptera, by C. O. **Waterhouse**; on the Entomostraca, by D. J. **Scourfield**; and on the microscopic examination of the sandy residue, by G. M. **Davies**. A carbonaceous deposit embedded in the low-level river-drift gravel of the Lea Valley, in the neighbourhood of Ponder's End, is described. It belongs to the close of the Pleistocene period, and is much later than the Moustierian deposits. It may be of Magdalenian age. It is more probably post-Magdalenian, formed during the time of the supposed archæological hiatus between the Palæolithic and the Neolithic epochs. The deposit yields a varied fauna and flora. The conclusions arrived at indicate climatic conditions similar to those now found in Lapland. The evidence of this comparatively late Arctic climate in the south of England is important. It throws light on many questions with regard to the relationship of Palæolithic man to the Glacial period. It may have been the Arctic conditions represented by the Ponder's End stage (as it might appropriately be named) which caused the migration of Palæolithic man to less inclement regions. The evidence is interesting as showing another important fluctuation of climate during the Pleistocene period.

Royal Meteorological Society, January 17.—Dr. H. N. Dickson, president, in the chair.—Dr. H. N. **Dickson**: Some meteorological observations. Meteorology has at the present time reached an important and critical phase in its history. This is due, in the main, to the operation of three principal factors:—(1) by the effluxion of time a mass of observational material has been accumulated which urgently requires examination and discussion with the object of ascertaining the precise meaning and value of the records and of improving routine methods for the future; (2) the rapid increase of knowledge of the conditions obtaining in the upper atmosphere has modified and is modifying current views as to atmospheric phenomena generally, and new interpretations must be placed upon the distributions observed at the surface of the earth; (3) the importance of applied meteorology in relation to agriculture and other activities of everyday life is becoming more generally recognised. It follows that there is in many directions urgent need for the extended prosecution of research work. Increase of popular interest and public support is necessary, and the active assistance of research workers must be enlisted. It is to be noted that the investigations required are of many different qualifications; they include the criticism and improvement of methods of routine observation, participation in organised exploration of the upper air, investigation of statistical and analytical methods of dealing with data already collected, investigation of mathematical or physical problems stated as the result of observation, and the examination or re-statement of geographical or other questions affecting the relation of meteorology to the problems of botany and other applied sciences.

Institution of Mining and Metallurgy, January 18.—Mr. H. Livingstone Sulman, president, in the chair.—Frank **Reed**: A submerged flexible-joint main. A brief description of the construction and laying of a 30-inch water-main across the valley of the mountain river Taramakau, New Zealand. For reasons of economy, the author decided to adopt the use of a submerged flexible-joint main in preference to a pipe bridge, despite the somewhat hazardous nature of the operation, due to the rapid flow and treacherous nature of the river to be crossed. The pipes used were 30 inches in diameter, with a length of 12 feet, with flanges at each end reinforced by brackets, and between each set of three of these sections a flexible joint was bolted, consisting of a ball and socket connection, sealed with a lead filling, which was found to be quite watertight. The pipe was laid in the river bed from a special pontoon moored between a line of piles. The main was laid on the river bed and then moored, and it was found that the bed silted over it and prevented it from shifting with variations in the current.—Cyril **Brackenbury**: Unwatering Tresavean Mine. A description of the method adopted during the past five years to unwater the Tresavean Mine in Cornwall, which was not only flooded, but in many parts of the shaft either partially or completely choked by débris. The depth of the main shaft was 1422 feet. Electrical high-lift turbine pumps were used for the unwatering process, but the operation involved a number of problems due to the existence of a former timbering and the extensive choking encountered, together with varying quantities of incoming water, according to the rainfall at different seasons of the year. Consequently, the average rate of sinking was subject to many fluctuations, and was sometimes for a brief period a minus quantity. Much valuable experience was gained during the process of unwatering the mine, which is given in detail by the author.—Humphrey M.

Morgans: Notes on the operation of two winding engines. The operations of the winding engines while engaged on various classes of work were recorded by means of a tachograph, the readings of which in diagram form were reproduced by the author, and afforded an interesting evidence of the characteristics of the different operations and their influence on the winding power.—E. P. Corbett **Sullivan**: Stoping at the Calamon Mine. A note on the method of stoping and filling adopted recently at the Calamon Mine. A conspicuous feature of the work is the preparation of inclined cuts, which are worked from the level upwards, and filled in practically in an automatic manner as the work proceeds.

PARIS.

Academy of Sciences, January 22.—M. Lippmann in the chair.—B. **Baillaud**: The accuracy of the knowledge of the time at the Observatory of Paris during the last months of 1911 and the commencement of January, 1912. A description of a new astronomical clock, Riefler D No. 228, recently presented to the observatory. The correction formula deduced from two months' observations is $C = -1 \cdot 54s. - 0 \cdot 20s.\ t - 0 \cdot 0015s.\ t^2$, and a comparison of the deviations of the observed values and those calculated from this formula gives a mean deviation of 0·03s.—L. E. **Bertin**: Presentation of some documents relating to the protection of warships and to dynamic stability.—Charles **Moureu** and Amand **Valeur**: The degradation of sparteine. The formation of a new hydrocarbon, sparteilene. In a previous paper it has been shown that by the successive application of Hofmann's method to the alkaloid sparteine an unsaturated base, methylhemisparteine, was the final product. Further application of the same method gives a dimethylhemisparteilene and a hydrocarbon, sparteilene, $C_{15}H_{20}$, the physical and chemical properties of which are given. Lack of material has prevented the determination of the constitution of this hydrocarbon.—A. **Müntz** and H. **Gaudechon**: The awakening of the soil. Experiments are given tending to show that the nitrifying organisms in soil commence to become active at a definite date, and this activity is not due to changes of temperature. The samples of soil, taken at different dates, were preserved at a constant temperature of 2° C., and all the other conditions of the experiments, including that of temperature, were kept rigorously constant. The maximum action was found to be between March 28 and April 25.—Léon **Labbé**: A potato disease, *la teigne*. An account of the measures taken to combat this disease.—A. **Lacroix**: The volcano of Reunion. A detailed description of the present condition of the volcano.—Paul **Sabatier** and A. **Mailhe**: The catalytic formation of the esters of the formenic series, starting with the formic esters. A mixture of isobutyric acid and methyl formate was passed in the state of vapour over titanium oxide at a temperature of about 250° C. Carbon monoxide was evolved, and the condensed liquid contained, besides methyl alcohol and unchanged isobutyric acid, methyl isobutyrate and an appreciable quantity of isobutyric aldehyde. No isobutyrone was found. Similar results were obtained by substituting isoamyl formate for the methyl formate. The substitution of thoria for titanium oxide as the catalytic material somewhat modifies the reaction.—M. **Bourgeois**: The results of the observations made by wireless telegraphy of the difference of longitude between Paris and Bizerta obtained by MM. Noirel and Bellot. Details are given of the method of observation, the mean error of the mean of a series being 0·04 to 0·05 sec.—Serge **Bernstein**: The asymptotic value of the best approximation of $|x|$.—H. **Parenty**: The progressive regulation of pressures at the entrance of a main distributing water, gas, or vapour. A detailed description of the instrument, with diagrams.—F. **Ollive**: The elastic pressure of saturated vapours. A new exponential formula is developed, and the figures calculated according to this formula for water vapour are compared with the experimental results.—L. **Decombe**: The theory of dielectrics. An investigation into the causes of the residual effects in dielectrics.—A. **Rothé**: The reception of meteorological radio-telegrams with reduced antennæ.—G. **Austerweil**: The passage of hydrogen through the rubber tissue of aërostats. Rubber, which is commonly employed as a waterproofing agent in balloon fabrics, is not a very suitable material for this purpose, as it absorbs hydrogen and allows the passage of the gas. Figures are given of the actual losses of hydrogen over a period of twenty days.—E. **Baud**: A general law of solution.—Daniel **Berthelot** and Henry **Gaudechon**: The photolytic decomposition of smokeless powders by the ultra-violet rays. The effects of the light from a quartz mercury vapour lamp on pure nitroglycerol and nitrocellulose were first studied, and then smokeless powders containing amyl alcohol and diphenylamine were examined. Tables are given showing the amount and composition of the gases evolved.—Camille **Matignon**: The synthetic formation of nitrous oxide. The application of the Nernst formula to the known thermochemical data of nitrous oxide shows that the amount of this gas formed from a mixture of nitrogen and oxygen at atmospheric pressure at a temperature of 2700° C. would be of the order of 2 in 100,000; at high pressures the amount might be higher.—D. **Tschernobaeff** and L. **Wolgodine**: The heats of formation of some silicates.—Louis **Hackspill** and Robert **Bossuet**: Some new alkaline phosphides. By working in a high vacuum with highly purified materials it has been found that the four alkali metals may be combined with phosphorus without explosion. The phosphides of cæsium, rubidium, potassium, and sodium thus obtained had the composition expressed by the formula M_2P_5.—G. D. **Hinrichs**: The true atomic weight of silver deduced from the experimental results of more than a century. The graphical method used in previous communications by the author has been applied to the data of Berzelius, Mather, Marignac, Stas, Maumené, Dumas, Baxter, Penny, Smith, and Richards. Taking the atomic weight of carbon as 12, the author concludes that the true atomic weight of silver is 108 exactly.—MM. **Portevin** and **Nusbaumer**: The influence of tempering upon bearing bronzes.—V. **Hasenfratz**: The bromine compounds of the alkaloids of *Peganum harmala*, and their basic derivatives.—P. **Carré**: The constitution of the glycerophosphoric acid obtained by the esterification of glycerol by means of phosphoric acid or the monosodium phosphate.—Marcel **Guerbet**: The action of caustic potash upon the secondary alcohols. The diagnosis of primary and secondary alcohols of high molecular weight. If an alcohol of high molecular weight is heated in a sealed tube to 230° C. with its own weight of potash, a primary alcohol gives a product entirely soluble in water; secondary alcohols undergo condensation, and the product on treating with water separates into two layers.—Étienne **Foëx**: The presence of two sorts of conidiophores in *Oidiopsos taurica*.—W. **Lubimenko** and A. **Froloff-Bagreief**: The influence of light on the fermentation of grape must.—Raoul **Dupuy**: Backwardness in infants and endocrinian polyopotherapy.—M. **Stapfer**: The utero-ovarian rhythm in woman.—R. **Pigache** and I. **Worms**: The thymus considered as an internal secretion gland.—H. **Colin** and A. **Sénéchal**: Is iron the catalysing agent in the oxidation of phenols by Raifort's peroxydiastase?—O. **Boudouard**: The smells of Paris. Unpleasant smells were particularly marked during the summer of 1911. A study of the conditions under which unpleasant smell may arise from manure works in Paris.—Georges **Bohn**: The sensibility of animals to variations in pressure.—Louis **Calvet**: *Watersia paessleri*, a parasite of *Polyzoa gordiana*.—A. **Legendre**: The *massif* of Ya-Long, western China, between 28° and 30°.

BOOKS RECEIVED.

A Monograph of the Mycetozoa. A Descriptive Catalogue of the Species in the Herbarium of the British Museum. By A. Lister, F.R.S. Second edition, revised by G. Lister. Pp. v+302+201 plates. (London: British Museum (Natural History); Longmans and Co., and others.) 30*s*.

The Evolution of Animal Intelligence. By Prof. S. J. Holmes. Pp. v+296. (New York: H. Holt and Co.)

Heaton's Annual, 1912. Pp. 562. (Toronto: Heaton's Agency; London: Simpkin and Co., Ltd.) 5*s*.

Wonders of Plant Life. By S. L. Bastin. Pp. x+136. (London: Cassell and Co., Ltd.) 3*s*. 6*d*. net.

Heredity in Relation to Eugenics. By C. B. Davenport.

Pp. xi+298. (New York: H. Holt and Co.) 2 dollars net.

Who's Who in Science (International), 1912. Edited by H. H. Stephenson. Pp. xvi+323. (London: J. and A. Churchill.) 6*s*. net.

Church's Laboratory Guide. Ninth edition. Revised and largely rewritten by Prof. E. Kinch. Pp. xvi+368. (London: Gurney and Jackson.) 6*s*. 6*d*. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Erste Lieferung. Pp. 1–160. (Jena: G. Fischer.) 2.50 marks.

Journal of the Institute of Metals, No. 2, Vol. vi., 1911. Pp. viii+369. (London: Caxton House, S.W.) 21*s*. net.

Meddelanden från Statens Skogsförsöksanstalt. Häftet 8, 1911. Pp. 279+xxiii. (Stockholm.) 2.25 kronor.

The A.B.C. Guide to Astronomy. By Mrs. H. Periam Hawkins. Pp. iv+120. (London: Simpkin and Co., Ltd.) 1*s*. 6*d*. net.

Spices. By H. N. Ridley, C.M.G., F.R.S. Pp. ix+449. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Manual Training Woodwork Exercises treated Mathematically. By F. E. Drury. Pp. xi+215. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—The Bacterial Production of Acetylmethylcarbinol and Butylene Glycol from Various Substances: Dr. A. Harden, F.R.S., and Miss D. Norris.—The Chemical Action of Bacillus Cloacæ (Jordan) on Glucose and Mannitol: J. Thompson.—On the Distribution of the Nerves of the Dental Pulp: J. H. Mummery.—A Method for Isolating and Cultivating the Mycobacterium Pseudo Tuberculosis enteritidis bovis (Jöhne), and some Experiments on the Preparation of a Diagnostic Vaccine for Pseudo Tuberculosis enteritis of bovines: F. W. Twort and G. L. Y. Ingram.—On the Fossil Flora of the Forest of Dean Coalfield (Gloucestershire), and the Relationship of the Coalfields of the West of England and South Wales: E. A. N. Arber.—Simultaneous Colour Contrast: Dr. F. W. Edridge-Green.—Studies on Enzyme Action. XIV.—Urease, a Selective Enzyme: Prof. H. E. Armstrong, F.R.S., and E. Horton.

LINNEAN SOCIETY, at 8.—Fourmis des Seychelles reçues de M. Hugh Scott: Prof. A. Forel.—Tipulidæ from the Indian Ocean: F. W. Edwards.—Sciaridæ, mit einem Anhang von Dr. J. J. Kieffer (Beschreibung neuer Sciariden von den Seychellen Inseln): Dr. Günther Enderlein.—Ichneumonidæ from the Indian Ocean: C. Morley.—New Fishes from Aldabra and Assumption, collected by Mr. J. C. F. Fryer: C. Tate Regan.

ROYAL INSTITUTION, at 3.—The Phenomena of Splashes: Prof. A. M. Worthington, C.B., F.R.S.

FRIDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 9.—Vital Effects of Radium and other Rays: Sir J. M. Davidson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steam-turbines: Some Practical Applications of Theory: Captain H. Riall Sankey, R.E.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—Presidential Address; Rocks containing Radiolaria: William Hill.

MONDAY, FEBRUARY 5.

VICTORIA INSTITUTE, at 4.30.—The Historicity of the Mosaic Tabernacle: Rev. Prof. J. Orr.

SOCIETY OF ENGINEERS, at 7.30.—Presidential Address: John Kennedy.

ARISTOTELIAN SOCIETY, at 8.—The Relation of Willing to Cognition: Prof. G. Dawes Hicks.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—*Discussion:* The Industrial Bursaries Scheme of the Commissioners of the 1851 Exhibition.—*Papers:* Constant Temperature Heating Apparatus for Explosives; Experiments on the Decomposition of Nitro-Cellulose: J. S. S. Brame.—Some Physical Constants of Structureless Cellulose Filaments (Artificial Silk): W. P. Dreaper and J. G. Davis.

ROYAL SOCIETY OF ARTS, at 8.—The Meat Industry: L. M. Douglas.

TUESDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—Report on the Deaths which occurred in the Zoological Gardens during 1911: H. G. Plimmer, F.R.S.—On Experimental Pheasant Breeding: Mrs. R. Haig Thomas.—Mendelian Experiments on Fowls: J. T. Cunningham.—A Further Collection of Mammals from Egypt and Sinai: J. Lewis Bonhote.—On the Pairing of Pseudoscorpiones: H. Wallis Kew.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Kayak in North-Western Europe: D. MacRitchie.

RÖNTGEN SOCIETY, at 8.15.—After-glow in Vacuum Discharge Tubes: Hon. R. J. Strutt, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Water-supply of the Witwatersrand: D. C. Leitch.—Investigations Relating to the Yield of a Catchment-area in Cape Colony: E. C. Bartlett.

WEDNESDAY, FEBRUARY 7.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual General Meeting.—Notes on the Determination of Butter Fat and Cocoanut Oil in Margarine: F. W. F. Arnaud and H. Hawley.—The Souring of Milk: H. Droop Richmond and H. C. Huish.—A Flour Improver: E. Hinks.

ENTOMOLOGICAL SOCIETY, at 8.—On the Comparative Anatomy of the Genital Tube in ♂ Coleoptera: D. Sharp and F. Muir.—On Some Hitherto Imperfectly-known South African Lepidoptera: Roland Trimen.—Notes on Australian and Tasmanian *Scydmænidæ*, with descriptions of New Species: A. M. Lea.

ROYAL SOCIETY OF ARTS, at 8.—The Influence of Ozone in Ventilation: Leonard Hill, F.R.S., and Martin Flack.

GEOLOGICAL SOCIETY, at 8.—On an Inlier of Longmyndian and Cambrian Rocks at Pedwardwine (Herefordshire). Dr. A. H. Cox.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Spectrum of Comet Brooks (1911*c*): Sir N. Lockyer, K.C.B., F.R.S.—A Chemically-active Modification of Nitrogen produced by the Electric Discharge. III.: Hon R. J. Strutt, F.R.S.—The Atomic Weight of Radium: R. Whytlaw-Gray and Sir W. Ramsay, K.C.B., F.R.S.—An Optical Determination of the Variation of Stress in a Thin Rectangular Plate subjected to Shear: Prof. E. G. Coker.—Spectroscopic Observations. Lithium and Cæsium: Dr. P. V. Bevan.—The Observation by means of a String Electrometer of Fluctuations in the Ionisation produced by γ rays: Prof. T. H. Laby and P. W. Burbidge.

ROYAL INSTITUTION, at 3.—The Phenomena of Splashes: Prof. A. M. Worthington, C.B., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—High Voltage Tests and Energy Losses in Insulating Materials: E. H. Rayner.

ROYAL SOCIETY OF ARTS, at 4.30.—The North-East Frontier of India: Sir Thomas H. Holdich, K.C.M.G., F.R.S.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 9.—Very High Temperatures: Dr. J. A. Harker, F.R.S.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Desert of North Africa: Captain H. G. Lyons, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steam-turbines: Some Practical Applications of Theory: Captain H. Riall Sankey, R.E.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address: Prof. A. Schuster, F.R.S.

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THURSDAY, FEBRUARY 8, 1912.

PARACELSUS.

The Life of Paracelsus: Theophrastus von Hohenheim, 1493–1541. By Anna M. Stoddart. Pp. xv+309. (London: John Murray, 1911.) Price 10s. 6*d.* net.

A PATHETIC interest attaches to this work. It is the last literary production of a gifted woman who had endeared herself to a large circle of friends by the sterling integrity of her character, by her remarkable intellectual power, her breadth of culture, and by her many-sided activities, especially in the educational world. The work itself represents the thought and labour of years, but the author died before it was given to the world, dying indeed a few hours after passing the last sheets for press. Twenty years ago Miss Anna Stoddart determined to devote her literary ability and her considerable linguistic attainments to what she came to regard as a sacred and imperative duty, namely, to rescue from contemptuous oblivion the memory of one whom the great majority of his fellows held to be an extravagant and pretentious charlatan—a bibulous braggart, uneducated, quarrelsome, self-assertive, and disreputable—and, while thus restoring his fair fame, place him in his true relation to the great moral and intellectual movement of the European Renascence.

Miss Stoddart is perfectly frank with her readers. She makes no secret of the fact that her interest in her subject had its sole origin in her connection with the Browning Society. Probably, like hundreds of the poet's readers, until Browning's poem quickened her curiosity, she had never heard even of the name of the alchemist, much less of the story of his life. The poet has admitted that his "Paracelsus," written at the age of twenty-one, was regarded by him simply as "the dramatic revelation of the soul of an imaginary person." Miss Stoddart tells us that many readers and admirers of the poem looked upon it in the same light: they "classed it with others which owed their emergence from subjective chaos to the poet's creative power." Browning, it is true, had equipped himself for his task by reading some of the writings of Paracelsus, together with a few biographical notes—mostly mendacious calumnies, according to Miss Stoddart. But, she adds, the "astonishing fact is that through this paucity of evidence and this cloud of hostile obscuration the poet discerned his greatness."

In grappling with such a subject as Paracelsus, the tentative work of the Browning Society, of the committee of which Miss Stoddart was a member for some years, proved unsatisfactory, and accordingly she sought by her own efforts to substantiate and amplify by historical research that which the creative power of the young man of twenty-one had evolved from "subjective chaos." As the result of her labours, Miss Stoddart has succeeded in producing a book of great interest, and of much literary charm, but whether it will bear the cold, impartial scrutiny of historians or altogether satisfy the sober lovers of truth may be doubted. To write unstinted eulogy is not necessarily to write sound history, and in her too evident desire to invest the real Paracelsus with the attributes of the "sympathetic revelation" of the poet, Miss Stoddart has permitted her zeal to outstrip her discretion, and in her passionate eagerness to rehabilitate her hero has given too little exercise to her critical skill.

The main incidents in the career of Paracelsus are now tolerably well known, and Miss Stoddart does not pretend that her researches have added much to our knowledge of the authentic facts of his extraordinary life. She seems to trust implicitly his own account of himself, and accepts unreservedly his explanations of much that is admittedly dubious in his character and conduct. His contemporaries, for the most part, declined to accept Theophrastus von Hohenheim—for such was his real name—at his own valuation; and the historians of chemistry and of medicine have, generally speaking, seen little reason to disturb the general verdict. At the same time, it cannot be doubted that circumstances, not altogether of his choosing, made of Hohenheim a representative man of his age. He was styled, even in his own time, the "Luther of medicine"—a term against which he vehemently protested, but which has nevertheless a certain basis of justification. He was disdainful and contemptuous of authority; he flung himself impetuously against the settled convictions and prejudices of the *Zunftgeist* of the time, and eventually was worsted in the struggle.

Although unquestionably a forceful character, a man of strong convictions, an iconoclast, reckless and intemperate in speech, he had no real constructive ability. He railed against the systems of Galen and Hippocrates, but his own attempts at reconstruction ended only in obscurity and vague generalities. As an operative chemist he did little; no particular discovery can with certainty be attributed to him. His life, indeed, was too unsettled, his means too precarious, and his wanderings too frequent for him to settle down to the serious pursuit of practical chemistry. Although his published works, or the many posthumous memoirs—some of them issued many years after his death—make mention of various chemical preparations, it is doubtful whether these are actually to be ascribed to him or whether they were not picked up by him in the course of his travels.

The service that Hohenheim rendered to his age was to unsettle and pull down. He left to others the task of reconstruction. He has been regarded as the first of the Iatro chemists—the first to declare loudly and unhesitatingly that chemistry had other aims than the transmutation of metals. Her main function, he taught, was to make medicines and not merely gold artificially. Others before him had dimly recognised that alchemy had gradually restricted herself to a single pursuit. Originally her operations were not limited to the artificial production of the noble metals. It is to Hohenheim's credit that he recalled her, in season and out of season, to her true vocation. He liberated her from the thraldom to which she had gradually subjected herself, and in so doing gave an extraordinary impetus to the study of rational therapeutics.

Miss Stoddart tells the story of his turbulent life in great detail, and she has apparently neglected no means available to her of tracing the successive steps of his chequered career. She has been aided in her search by German scholars like Sudhoff, Hartmann, the Strunzs, and others, and whilst we may deprecate the glamour with which she has sought to surround her subject, we bear willing testimony to the patience and unwearied devotion she has brought to her self-imposed task.

Worn out by persecution, homeless and a wanderer to the last, Hohenheim ended his strenuous life at Salzburg on September 24, 1541, in the forty-seventh year of his age. On a tablet to his memory in the Church of St. Sebastian are the words, "To the living Peace, to the Sepulchred Eternal Rest." What irony! Paracelsus knew no peace in life, and even death brought little rest to his bones. His remains have been constantly disturbed, most frequently in attempts to disprove the allegation that he met his end by violence.

A CARBONIFEROUS FLORA.

Mededeelingen van de Rijksopsporing van Delfstoffen. No. 3. Anleitung zur Bestimmung der Karbonpflanzen West-Europas, mit besonderer Berücksichtigung der in den Niederlanden und den benachbarten Ländern gefundenen oder noch zu erwartenden Arten. By Dr. W. J. Jongmans. Band i., Thallophyta, Equisetales, Spenophyllales. Pp. viii+482. (Herausgegeben von der Staatlichen Bohrverwaltung in der Niederlanden.) (Freiburg in Sachsen: Craz and Gerlach (Joh. Stettner), n.d.) Price 15 marks.

IN this volume Dr. Jongmans states that his aim is to bring together information contained in the very extensive literature relating to West European Carboniferous plants. He asks readers to bear in mind the fact that he would have preferred to deal with the material more critically than has been possible without an examination of the numerous original specimens scattered in European museums, adding that what he has done should be considered as the arrangement of building material rather than as the construction of the complete edifice, a task postponed to a later stage.

The volume is written especially with a view to facilitate the determination of Carboniferous plants, and for this purpose it cannot fail to be of great value. The two bulky volumes on the bibliography of fossil plants published in 1910 and 1911 are in themselves a striking testimony to the devotion of Dr. Jongmans to palæobotany and to his willingness to give his time and energy to tasks which few students would attempt. In the volume before us we have further evidence of the author's industry and of his wide acquaintance with the literature of the subject.

In dealing with fossil plants, an author may confine himself to concise descriptions and a liberal allowance of illustrations in order to furnish students with data for the determination of species, or for the study of distributional problems; or he may treat the subject from the point of view of a botanist who wishes to present facts relating to the structural and general morphological features of extinct types. Dr. Jongmans's book is chiefly of the former kind, and contains a wealth of information culled from many sources, together with first-hand observations.

An inspection of the different sections of the volume raises some little doubt as to the complete success of the undertaking; even a few good illustrations of anatomical features would have considerably increased the interest of the descriptions, and the impressions and casts would have acquired a much greater interest and vitality. A correlation table of Carboniferous strata in different countries would be a welcome addition in a work which will be used by students of stratigraphy; while, on the other hand, one feels that, the author's aim being what it is, the treatment would be more helpful were it more critical.

The perusal of a volume such as this inevitably suggests the question, is the result achieved commensurate with the enormous labour involved? To give an answer in the negative might seem ungracious considering the thoroughness of the work and the undoubted service rendered by the author; but it is difficult to repress a tendency to wish that Dr. Jongmans had not carried self-sacrifice quite so far. To this volume, in which the author has unquestionably performed a welcome service in arranging and presenting in a convenient form a mass of scattered information, one may apply Huxley's words, "It is the organisation of knowledge rather than its increase that is wanted just now," though from a scientific point of view one cannot help feeling that the elaborate treatment of the *disjecta membra* of Carboniferous plants as represented by fragmentary casts and impressions may endow them with an importance greater than they deserve.

The tables scattered through the book, designed to assist the systematist in distinguishing between allied species, are a new feature, and should prove useful in practice, even though many of the characters on which supposed species are founded are altogether insufficient if scrutinised in the light of modern plants.

It is impossible in a short notice to do justice to the contents of the volume. The book is essentially a work of reference, and students of Carboniferous plants, whatever may be their views as to such points as I have raised, must acknowledge themselves indebted to one who has produced a well-ordered storehouse of data, valuable alike to those whose interests are chiefly stratigraphical and to those who are primarily concerned with the study of fossil plants as guides to phylogeny.

The account of the Equisetales occupies 350 pages. A short description of the group is followed by a concise description, with figures, of the known Palæozoic species referred to Equisetites and placed in the family Equisetaceæ. Under the second family, Protocalamariaceæ, three species of Asterocalamites are described, and full references and synonyms are given, also the geological horizons. The greater part of the volume is taken up with the numerous species of the genus Calamites, their identification being greatly facilitated by clear keys and well-chosen illustrations.

As the author admits, many of the so-called species and even the subgenera of Calamites are of little or no scientific value; but the reader has placed before him in a convenient and accessible form abundant information from a scattered literature, from which he can form his own opinion as to the value of supposed specific differences, and is enabled to obtain a comprehensive view of the genus as a whole and of its geographical distribution. A. C. SEWARD.

EARLY EGYPTIANS AND ANCIENT CIVILISATION.

The Ancient Egyptians and their Influence upon the Civilisation of Europe. By Prof. G. Elliot Smith, F.R.S. (Harper's Library of Living Thought.) Pp.xvi+188. (London and New York: Harper Brothers, 1911.) Price 2*s.* 6*d.* net.

WE think that "The Early Egyptians and their Influence on Ancient Civilisation" would have been a better title for Dr. Elliot Smith's little book than that which he has actually chosen, "The Ancient Egyptians and their Influence upon the Civilisation of Europe"; for Dr. Smith deals only with the most ancient, the earliest Egyptians, and he traces their influence not only upon the civilisation of Europe, but also, and in the first place, upon that of northern Africa and western Asia. We may say at once that Dr. Smith is less happy in his essay to trace this influence than when he is simply analysing the ethnic constituents of the race which exercised it. In dealing with the complicated question of possible early Egyptian influence upon the surrounding peoples, with regard to which our information is of the scantiest and most nebulous character, he is straying rather off his own ground, whereas in dealing with the early Egyptians themselves he is not only upon his own ground, but upon ground which he himself has made. To read him on this subject is indeed to be enlightened, and every historian must read with attention the remarkable conclusions to which he has been led by his experience in the dissection of mummies (gained in the course of his medical work at Cairo) in connection with the severely scientific archæological work of Dr. Reisner and his assistants at Nag' ed-Deir and in Lower Nubia.

His discovery that a more northern race infiltrated into Egypt, probably from Syria, from the time of the earliest dynasties, and gradually modified the Egyptian "dynastic" type from the beginning, is very illuminating, as it explains the occurrence in Egypt, and more especially in northern Egypt, of the "stumpy," stout, rounder-faced type which we see in the portrait-statues of the pyramid-builders, so different from the lank-faced prehistoric Nilote of predynastic times. Dr. Elliot Smith's arguments are based chiefly upon craniological considerations. Those who recall Prof. Flinders Petrie's incisive criticism of the argument from craniology in his essay, "Migrations," some years ago, may perhaps be a little sceptical of all Dr. Smith's conclusions, yet it must be said that his arguments are reasoned, and his conclusions consistent with themselves and with archæological results. The ancient portraits of the two races agree with the skulls. We may, with him, regard the "predynastic" Egyptian as the true Nilote, akin to the desert tribes of Beja and Bisharin, to the Galla and Somali, and perhaps to the Arabs, while the new "dynastic" type of the north was probably akin to the high-nosed, round-headed stock of western Asia, which von Luschan calls "Armenoid," because the Armenians are the best representatives of it.

The high-nosed Semites of Asia may be a mixture of this stock with the true Arabians of the south, but if the Sumerians of Babylonia are representatives of the southern race, which spread from the Upper Nile to the delta of the Euphrates, and even to India, as Dr. Smith seems to hold, how does he explain their remarkably high noses? I would suggest that they may have been "Armenoids," not southerners, who conquered the original southerners (Semites), to be themselves in turn conquered by the Semites who had imbibed Sumerian civilisation. There are facts which point to the existence of a pre-Sumerian Semitic population in Babylonia. On this view the Semitic speech will belong to the southerners, the true Arabians, and, if so, the very ancient Semitic elements in the Egyptian language and culture will belong to the predynastic people, not to the northerners. But this conclusion conflicts with the fact that the most Semitic cults of Egypt, as, for instance, that of Ra, the sun-god of Heliopolis, belong to the north; the southern cults are the least Semitic, and the predynastic culture of the chalcolithic age is by no means "Semitic" in appearance.

This is a problem raised by Dr. Elliot Smith's book, and it is one of great interest and importance. Less important seems his view that the impulse to megalithic building in northern Africa and western Europe was given by the influence of the great stone buildings of early Egypt. Here it is difficult to follow him, and he seems to exaggerate the extent of the early influence of Egypt on the development of the surrounding civilisations. One is by no means inclined yet to attribute the whole development of early European culture to Egypt; there are many conflicting facts which have to be taken into consideration. It is by no means certain that Dr. Reisner's view that the early Egyptians were the inventors of copper-working is correct. Dr. Smith thinks the fact proved; others may doubt it. We should like to hear the views of Prof. Petrie, Dr. Gowland, and Prof. J. L. Myres on the point. Dr. Smith is dogmatic, of course; how is it possible to be otherwise in a little book of less than two hundred small pages? Were one to give all one's arguments *pro* and *con* in respect to so nebulous a subject as this, one would write volumes. And in a review it is impossible to argue at all on the doubtful points. One can only say that these, while important, are by no means many, for Dr. Smith has told us much that seems incontrovertible, and his book is one of the most important recent contributions to Egyptian archæology. Again, one can only regret its title, which does not explain the book properly.

H. R. HALL.

NATURE-BOOKS.

Round the Year with Nature. By W. J. Claxton. Pp. xvi+302. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7s. 6d. net.

TO write a satisfactory introduction to natural history for children seems to be a difficult task. After examining some hundreds of attempts and testing them practically, I find that the most successful results are obtained by the following type. This has three characteristics: (1) the number of species described is practically complete for the British Isles—if the more significant foreign species can be included, so much the better; (2) there are pictures of every species described; (3) the descriptions, both pictorial and verbal, are of the diagrammatic order; in other words, rigidly scientific. The more nearly the pictures approach the geometric style, and the language the Euclidean—simplified—the better is the result, both for the child's intelligence and actually for his interest. He wants neither baby-language nor mawkish sentiment, nor teleological moralising; he wants solid fact and plenty of it. Those fine photographs from wild life are rather wasted on him unless they approach diagrammatic completeness. The pictures he gets most out of are those which resemble the best kind of toy, namely, the lay-figure type, which can be taken to pieces. His imagination does the rest. He has also an unvoiced demand for some admixture of the comparative method and of evolutionary theory.

This is no attempt at paradox, but a tested conclusion. The teacher is apt to make two mistakes; he either tries to "get down to the child's level," or assumes that the child has no interest, and that this must be created. As for the first, the child has no difficulty in understanding biological fact or biological theory; his only handicap is unfamiliarity with the abstract words and abstract ideas used so largely by his elders. It is this alone which constitutes the difference of level, and it is the teacher's fault if he cannot make his demonstrations concrete. As for the second, the child's interest needs to be attracted; it exists of itself, and develops by assimilation of material, not of other people's exhortations.

Mr. Claxton's book has the merit of giving the child a mixed diet; facts and pictures, zoological, botanical, and miscellaneous, are judiciously combined. Some children never get beyond "fur and feathers," because other roads have not been pointed out. The country-walk method was also Mr. Barlow's, and it is a good one.

But the author wastes much effort and space. The bulk of the volume consists of poetry—an infallible method of damping the child's interest and of imparting error—of antiquated moralisings, and of attempts to stimulate interest—attempts which are nothing but the notes of exclamation which the child himself may supply. There is far too much admiration of the wonderful wisdom and provision of "Dame Nature." Of the sparrow-hawk Mr. Claxton says:—"I do not think anyone who loves birds can admire this fierce-looking creature, and when I have seen one in a keeper's bag, I have not had much sympathy for her." Yet he waxes enthusiastic over wasp-extermination, otter-hunting, coursing, and pheasant-shooting, and never fails to mention a "luscious" morsel, or something that will make "your mouth water." The nightingale does not haunt the tree-tops, nor was Daphne "one of the most famous of Greek goddesses." He explains that the crocus-corm is not a bulb, but speaks of the gladiolus bulb. To describe the kestrel as "of a greyish colour with a blue tint," and the nightjar's note as "a jarring sound," is scarcely satisfactory. "There are many kinds of elm in England, but possibly the common elm and the wych or Scotch elm are the best known" is somewhat mysterious.

The majority of the bird and mammal pictures are from stuffed specimens. Many of these, as the robin, rook, and swallow, are unfortunate. Many of the plant pictures suffer from indistinctness. The method of Bewick and Sowerby is preferable to this.

A. E. CRAWLEY.

FOOD AND DIETETICS.

Food and the Principles of Dietetics. By Dr. Robert Hutchison. Pp. xx+615. With plates and diagrams. Third edition, revised and enlarged. (London: Edward Arnold, 1911.) Price 16s. net.

"THACKERAY is said to have remarked that he got some of his best thoughts 'when driving home from dining out with his skin full of wine.' We need not doubt it, for the statement embodies a physiological truth. It *was* his skin which was full of wine, for alcohol dilates the surface blood-vessels. . . ." Impressed in such a manner, this minor measure of physiological truth is seen on its way towards penetration of the reader's interest and retention in his memory. If any advocate of temperance doubts the sense of judgment which appears to admit the major portion of Thackeray's statement as equally a physiological truth, he will probably change his mind on reading the excellently balanced articles in this volume dealing with this and similar controversial subjects. He will in any case admit the value of the admirable style in which the author's opinions are clearly conveyed, leaving not one of the many "pros" and "cons" swathed in any mist of verbal confusion.

Nor is this quotation quite a fair sample of the many skilful efforts by which Dr. Hutchison has secured attention. The effort is more frequently less obvious and the measure of truth even greater. One might instance cases where his trap is baited with appeals to the special taste more intimately associated with his subject. Thus a tabulated comparison of the chemical constituents of different cheeses and a careful consideration of their economical value follows quite naturally the interest awakened by this palatable prophecy:—

"We may look forward then, perhaps, to tasting cheeses hitherto unknown, and to combinations of flavour as yet unsuspected. We may combine the virtues of Stilton with Gorgonzola, or those of Gruyère with Roquefort, for the artist of the palate will have in his hands the precise instruments of science."

If this book was deprived of these special qualities,

in which it is so rich, we should still possess in it a collection of scientific information well arranged in rightful sequence, and as a whole of very direct importance to mankind—of so much importance, indeed, that in some degree it should be at the command of the caterer and the cook, as well as of the physician. The present edition has been specially improved in those parts of more immediate importance to the medical practitioner, and this is natural because of the occupation of the author, but is also probably a consequence of the special market which the book has found. It will, however, be well when such a book reaches the wider market for which it is intended, as will no doubt happen when present efforts to provide an adequate training in "domestic science" have gained a deeper and wider success. When that time arrives "hygiene" will have permanently lifted its head above drain-pipes and fevers, and passed even the limits of interest in rickets and in defective vision.

Developing schemes of public health lead us to anticipate a time when the committal to memory of the symptoms of incipient disease will no longer form part of the responsibility of the general public. So much at least we might infer from the manner in which the medical supervision of schools and workshops, and even of homes, is passing into the hands of inspectors and nurses under the control of medical officers of health. Responsibility for the possession of some of the knowledge contained in this book will, however, never pass away from the individual householder, certainly never until the "State" is actually the householder and the "State doctor" the mother of every family in the kingdom.

In certain unimportant particulars patient scrutiny reveals the fact that faults might occasionally be found in this book, but *cui bono?* The book is sound and comprehensive, the author extremely able and entertaining, the present edition an improvement on its forerunners, and the subject of vital interest to the community. Space should be found for it in the library of every educated family as necessarily as in that of every practitioner of medicine. To the latter it is now no longer needful to plead for its welcome.

J. S. MACDONALD.

THE CONSTANTS OF NATURE.

(1) *Tables of Physical and Chemical Constants, and Some Mathematical Functions.* By Dr. G. W. C. Kaye and Prof. T. H. Laby. Pp. vii+153. (London: Longmans, Green and Co., 1911.) Price 4*s.* 6*d.* net.

(2) *Smithsonian Miscellaneous Collections.* Vol. 58, No. 1, Smithsonian Physical Tables. Prepared by F. E. Fowle. Fifth revised edition. Pp. xxxiv+318. (Washington: Smithsonian Institution, 1910.)

THESE two volumes of newly compiled tables of physical and chemical constants cover very much the same ground, though differing greatly in many respects. The larger volume of 318 pages is a revised edition of the famous Smithsonian tables, bearing on the title-page the name of Mr. F. E. Fowle, of the Astrophysical Observatory, as its compiler. It is issued as an official publication of the Smithsonian Institution. The smaller tables of Dr. Kaye and Prof. Laby are the first issue of an entirely new work by private individuals.

In the prefaces to the larger book, by Dr. Wolcott and Mr. Fowle, it is stated that the earlier tables of Prof. Thomas Gray have been almost entirely rewritten for this fifth edition. Both books claim to be practical and thoroughly up to date; a comparison of them is therefore legitimate and instructive.

(1) Messrs. Kaye and Laby's book of 153 pages is pleasingly got up and very well printed, an enormous amount of material having been carefully dovetailed into a limited space. Heavy type and separation lines are freely used to bring the important features into prominence, thus assisting the eye in finding what is wanted. The work consists of nine sections, entitled—general physics, astronomy, heat, sound, light, electricity, magnetism, radio-activity and gaseous ionisation, chemistry and mathematical tables, together with a good index. One of the most important features, which distinguishes the book from previous compilations, is the fifteen-page section on the constants of radio-activity, a field of work which has grown enormously during the past ten years, and has hitherto been entirely neglected by compilers of tables. This section bears the marks of expert treatment. In the case of most of the important constants the names of the authorities are given throughout the book, with dates and references to original papers. The introductory paragraphs to the tables are many of them especially good, and great discrimination seems to have been shown in the selection of the best determinations for the tables instead of loading them up with matter which only deserves a place in a detailed historical *résumé*, and has long since for practical purposes been relegated to the scrap-heap. The values of the constants given are, so far as we have seen, thoroughly up to date. Thus in the tables of melting points of the elements only ten of the determinations for which the year is given date from earlier than 1900, while sixty-five fall within the present century.

We have submitted the book to a very close examination, and found in it extremely few mistakes. Among these may be mentioned a conspicuous one on p. 47, where, in the thermoelectric tables relating to 10 per cent. platinum-rhodium and platinum-iridium couples, the values of the E.M.F. shown should all be multiplied by 10. On p. 64 the calorific value of illuminating gas is given 1000 times too small, and in the section on electrochemical equivalents on p. 123 the figures for copper and hydrogen require correction to 0·0003295 and 0·00001045 respectively.

The compilation of a book of this kind must have involved immense labour, and every credit is due both to authors and publishers for the result accomplished. We have no hesitation in most cordially commending the work to physicists, chemists, and engineers as by far the best small book of its kind, and likely to prove exceedingly useful. In view of its very moderate price teachers of experimental science would, we think, be well advised in prescribing this volume of constants as a necessary text-book for those attending their courses.

(2) Turning now to the Smithsonian volume, and having in advance set up a high standard of expectation, we must confess to a feeling of some disappointment on a critical examination. Comparing the present edition with that of 1896, the work of revision does not seem to have been as drastic as might have been expected, and some of the changes appear to the writer to be doubtful improvements. For example, most of the conveniently arranged tables of conversion factors occupying the first twenty-seven pages have disappeared.[1] While not wishing to criticise unfairly so famous and eminently useful a work as these tables have been, we notice throughout a good deal of carelessness in detail, which might easily have been obviated by more critical proof reading. One of the most serious general blemishes is a pronounced tendency continually to misspell proper names, and an extraordinary lack of system seems to have crept in regarding the way of indicating joint authorship of a paper. In about half the instances noticed, the names of the two authors have been hyphened together with, at times, curious results. "Roberts-Austen" we know, but who is Mr. "Baly-Ramsay" or Mr. "Thorpe-Rogers"? With "Thomson-Houston" everyone is acquainted, but we confess to learning with considerable astonishment that specific heat determinations were made by Mr. "Barnes-Regnault." On the other hand, Ayrton and Perry, Heycock and Neville, Perot and Fabry remain "dissociated."

There is a considerable lack of critical faculty in the choice and mode of presentation of some of the data. From a comparison of the gravity tables in Kaye and Laby with this volume the meaning of this criticism will at once be evident.

In the chemical sections of the work the nomenclature is often lacking in system. Thus we find on p. 232 "Nitrogen *tet*roxide NO_2," and on p. 212 "nitric *per*oxide N_2O_4." The hydrocarbon C_6H_6 is spoken of as "benzene," "benzol," and "benzole," and is also probably intended in at least one instance when spelt "benzine." This last name is used, in this country at all events, for a quite different body, which is a mixture of saturated paraffins of low boiling point, variously called benzoline, petroleum-ether, and petrol.[2]

A chemist travelling with his impedimenta, say on the South-Eastern Railway, will be able to ascertain from the table on p. 85 that if he took with him a cubic foot of cæsium, he would have to pay excess luggage, that quantity being stated to weigh 117 lb. The only mention of radium or radio-activity or of the rarer gases of the atmosphere except argon is in the table of atomic weights, and ionisation is only treated in the chemist's and not the physicist's sense of the term.

The table of melting points of inorganic compounds is misleading in that from it one would imagine that many of these substances melted over a range denoted by the limits "max." and "min." rather than at a point, and the column headed "average" value on p. 211 becomes the "probable" value over the leaf.

In table 226 it is twice stated that "1 joule = 1 watt per sec.," and in the appendix some curiously unfamiliar units are mentioned. Few people will be able to define a "metret" or a "barad."

The value of the Wien constant to give a platinum melting point of approximately 1750° C. is not 14,000, but more nearly 14,500, and the table for reduction of platinum thermometer readings mentioned in the title on p. 235 seems to have dropped out.

After mentioning these defects it should, however, be stated that the book has many good points, the mathematical tables comprised in it being in particular a very useful selection.

A considerable list of minor misprints and inaccuracies, too long for insertion here, has been prepared, and is being forwarded to the author.

J. A. HARKER.

[1] In table 31 of the old edition, "Conversion of quantities of heat," many of the figures given were wrong by 10^6; thus, 1 B.T.U. = 252 grm.-calories—not 0·00025 as stated.

[2] Strictly speaking, these terms are not synonymous, but are applied to different fractions of the same product.

PRACTICAL AND THEORETICAL PHYSICS.

(1) *Notes on Practical Physics.* By Dr. A. H. Fison. Pp. viii + 144. (London: Edward Arnold, 1911.) Price 3*s.* 6*d.*

(2) *College Physics.* By Prof. J. O. Reed and Prof. Karl E. Guthe. Pp. xxviii + 622. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 12*s.* net.

(1) THIS little book treats of such an elementary course of practical physics as is usually prescribed for medical students in their preliminary scientific training. As its title suggests, no attempt is made to give an account of the theory of each experiment or even a complete description of how to conduct it, but there is enough to save a demonstrator much wearisome repetition, and allow him to devote himself more to a discussion of each experiment, and to removing the difficulties of individuals. There is no "spoon-feeding," but, on the contrary, attention is directed to the principles involved and to possible difficulties and errors in a way calculated to encourage thought on the part of the student. The book should prove decidedly useful, and, if properly used by teacher and class, should increase the educational value of such a course of practical physics.

For each experiment an important indication is given of its general character as regards accuracy, and the author insists on the importance of considering the degree of accuracy attainable and of seeking that, and paying attention to no more than that, in the various observations and measurements to be made.

Some improvement in details is desirable. The treatment of mirrors should be independent, and not derived from or made analogous to that of lenses. If necessary, space for this could be obtained with advantage by omitting such an experiment as the determination of the earth's horizontal component of force, which could only be treated very partially. There is an occasional pandering to students' weaknesses, as in permitting the use of a chosen length for a simple pendulum in order to save arithmetic, or as in taking 100 c.c. of water in a calorimeter and

removing the thermometer from the calorimeter during the introduction of a hot body, though the calorimeter is weighed to 0·1 gram. The use of a thermometer as a stirrer is scarcely to be commended, except it be from the manufacturer's point of view.

(2) This is a well-arranged and concise presentation of the facts of physical science and of the accepted principles underlying them. It deals first with mechanics, hydrostatics, molecular phenomena, and sound; then with heat, magnetism, current electricity, and electrostatics; it gives an account of radio-activity and the electron theory; and finally treats of light and radiation in general. In each of these branches there are few subjects or experimental methods to which some reference is not made, and it is surprising to find so much information in a book of the size. It would not be fair to describe it as a mere compilation of facts, as it gives accounts of current theories and usually the "reason why" for any statement. But these are necessarily so concise and brief that beginners, and many who could scarcely be termed beginners, though they might learn the facts, would scarcely appreciate the reasoning or form an adequate conception of the theories and the relation of facts to them. Anyone with considerable previous knowledge of the subject who is looking for an account of the present state of physical science will find it here given in a sound, clear way; and the book should be of value to honour students, if read as an introduction to those in which theories are more fully dealt with. The authors frequently point out the necessity for this, but the difficulties connected with theories or their incompleteness are not sufficiently presented. There is so much apparent plain-sailing that it is to be feared that too many will think that the book contains enough for them. However, the authors' warnings may, and lecturers should be able to, prevent students making this mistake.

The book is intended to be read along with the "Manual of Physical Measurements," by the same authors, to which students are referred for details regarding experiments.

Numerous references to original papers are given.

OUR BOOK SHELF.

Elements of Agriculture: a Text-book prepared under the Authority of the Royal Agricultural Society of England, by the late Dr. W. Fream. Eighth edition, Edited by Prof. J. R. Ainsworth-Davis. Pp. xiv+692. (London: John Murray, 1911.) Price 5*s*. net.

WHILE British agriculture is, by common consent, at least as highly developed as any system that can be found in any other country, it has by no means a copious modern literature. Among the comparatively small number of text-books on the subject one by Dr. Fream has for many years stood pre-eminent, and has, indeed, become a traditional part of our agricultural education. The book might have defects, and it was undeniably out of date in many places, but it had served for generations of students, and must therefore have merit. And further, as time went on, no competitors arose, so that it has remained in possession of the field.

To revise even a small agricultural text-book is not a task to be lightly undertaken. The professor of agriculture is very unreasonably expected to be an authority on botany, chemistry, geology, physiology, and "other sciences underlying the production of crops and live stock and the cultivation of the soil." But to so experienced an editor as Principal Ainsworth-Davis these difficulties are not serious, and the revision of the separate chapters appears, so far as one man can judge, to have been satisfactorily accomplished. It would have added to the interest of the book, and enabled the discriminating teacher to evaluate the different sections, if an indication could have been given showing who was the reviser in each case.

It is, however, a very difficult matter to piece new material into old and make the whole into a coherent story. Thus in the chapter on "Soil" p. 15 tells the old tale and p. 17 the new. "Clay," on p. 15, is used in the rather indefinite sense in which Schübler used it in 1838, which meaning it retained until Warington in 1900 introduced the newer and more definite conception from America. "Clay" on p. 17 is something altogether different; the word is here used in the modern sense of material the particles of which are below a certain arbitrary size; hence the numbers on p. 15 are wholly inconsistent with the use of the word on p. 17. A sandy loam, for instance, does not contain more than about 10 per cent. of what is now called clay, although on the old view it might contain 40 per cent. Probably no soil contains more than 45 per cent. of clay in the modern sense, and yet in the old days (and on p. 15) certain soils were said to contain 95 per cent. Difficulties of this kind, however, are almost inevitable with words that have changed their meaning, or, still worse, as in the present case, taken on an additional meaning.

A remarkable feature of the book is its cheapness. The book runs to 700 pages, is well illustrated, printed on good paper, and nicely bound, and yet only costs 5*s*. It is therefore within the reach of the agricultural student (who is not naturally a book buyer), and may reasonably look for a long lease of life. Principal Davis has certainly made it once more the best British text-book on agriculture.

E. J. R.

Annual Report of Recent Advances in Pharmaceutical Chemistry and Therapeutics. Vol. xxiv., pp. 419. (Darmstadt and London: E. Merck, 1911.) Price 1*s*. 6*d*.

THIS work is a very complete summary of researches carried out during the year 1910 in therapeutics, and, to a less degree, in the chemistry of drugs. Full and interesting accounts of the cacodylates and of kephir from their introduction into therapeutics occupy a considerable part of the volume. From the references to arsacetin and atoxyl the latter appears to have certain advantages over the former, especially in cases of trypanosomiasis. Messerschmidt's benzidine test for blood is discussed in detail, and seems to have value as a negative rather than as a positive test. Light is thrown upon the mode of action of chrysarobin in skin diseases by Unna and Goldsetz's observation of its oxidation on the skin to oxychrysarobin and chrysaloxin. The introduction into the German pharmacopœia of the formaldehyde sulphuric acid test for chloroform is commended, although admittedly the nature of the impurities excluded by it are not known. In view of the fatal effects that are from time to time reported of the use of chloroform as an anæsthetic, it is essential that stringent tests to ensure its purity should be adopted. The report should prove especially valuable to medical practitioners and to pharmacists, as it contains in readily available form abstracts from journals, many not easily accessible, relating to the constitution and action more particularly of modern synthetic remedies.

HENRY G. GREENISH.

Tennyson and his Friends. Edited by Hallam Lord Tennyson. Pp. xiii+503. (London: Macmillan and Co., Ltd., 1911.) Price 10s. net.

THIS interesting collection of articles and reminiscences, nearly all by the personal friends of the late Lord Tennyson, and brought together by his son, will be a valuable addition to the Tennyson literature.

The book may be looked upon as a supplementary volume to the Memoirs, which appeared about four years after his death, for it gives a still further insight into the life, friendships, and opinions of the great poet.

A description is given of the early days in Lincolnshire and of the Somersby friends; also of his two brothers, Frederick and Charles, who were nearest him in age, and with whom he was most closely associated in school and college days.

Other articles give his intercourse with Lushington, Fitzgerald, Carlyle, Thackeray, Clough, and many others.

Tennyson's attitude towards science is shown in articles by Sir Norman Lockyer and Sir Oliver Lodge. The former points out "his unceasing interest in the causes of things, and in the working out of nature's laws," and compares him with Dante in this respect, more especially in the way he kept abreast of his time.

To the articles, some of which are reprints, are added several of the poems written by Tennyson to his Cambridge friends and to those of later years. The collecting into one volume of these many writings of interest cannot fail to give pleasure to all his admirers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Microscope Stands.

THE discussion on microscope stands will do little good if it is directed towards the production of a universal type of instrument. As a maker of microscopes, I come into close contact with many branches of work the requirements of which are totally different. To make but one form would be a fatal mistake. The metallurgist cannot use the instrument which is best suited for the bacteriologist, neither will the Rosenhain metallurgical microscope suit the biologist. The Dick petrological microscope is quite unsuitable for the entomologist, and the binocular instrument, which demands long tubes and a great range of focus for the use of the lowest powers, will not satisfy the chemist. For the use of botanists, zoologists, and bacteriologists there is a certain similarity of requirements, but even here it would be unwise to endeavour to make all microscopes on one model. The work of the student in the botanical laboratory is totally different from that of the research worker who is making photomicrographs with the highest power immersion lenses.

The development of the microscope in the future will probably be in the direction of producing specialised types for specific work. Thus discussion on microscopes in general rather than of definite types is difficult, and is liable to become discursive. It can also only be misleading to set up a false comparison between English and Continental types. No such types exist at the present time.

English microscopes are made which are almost facsimiles of instruments of Continental manufacture, and although Continental makers were slow to realise the advantages of the more perfect adjustments provided from the earliest days in English microscopes, they have commenced to do so. The so-called Continental mechanical stage was invented by John Mayall, and placed on the market by at least three British firms before it was applied to foreign microscopes, and therefore the terms English and Continental have no meaning as describing types of instruments. A few questions which apply to all microscopes may be discussed generally, but the more definite points must be considered in connection with the branch of work for which the instrument is required.

The comparison of rigid as against spring fittings for the adjustments applies to all classes of the instrument, and a full discussion of this point can, in my opinion, only lead to one conclusion. The microscope must, above all things, have adjustments which are rigid and free from spring or tremor. They must be absolutely firm, and yet must respond to the slightest movement without either backleash or sag. The adjustments consist of metal slides worked by a screw, either direct or by means of a lever or cam, or by a rack and pinion. For the fine adjustment the sliding portion must be kept up to its work by a spring to prevent backleash. The slides or fittings of a microscope must be the very finest that skill can create, and to secure this they must fit throughout their entire length or the greater portion, and not at a few small points; being scraped or ground, so that the whole of the surfaces bed together; thus only can a perfectly rigid slide free from swerve, backleash, and tremor be obtained. If this is done, the wear that takes place during many years' constant use will be quite inappreciable, as there is no load on such fittings. The provision of spring pieces to take up wear is not only unnecessary, but injurious, because once such spring pieces come into play, the fittings will henceforth depend on the friction at a few points instead of a large surface.

Such fittings are not stiff, and become loose because they bear at a few points only, and are held up by screws which are liable to shake loose. It may be argued that if the slides were fitted accurately and the spring pieces were inoperative, only being there for use in case of wear, an advantage would be gained. That is not done in practice, for if the screws holding the spring pieces of a slide so made are released, it will be found to be quite loose. Moreover, it requires a skilled workman to set up the slide of a slow motion fitted with such spring pieces to obtain a perfect motion free from backleash or sag, and it is much better that he should refit the original well-fitted slides. Spring fittings are mechanically wrong for this purpose. Who would think of having an adjustable spring fitting for a theodolite centre? The quality of the adjustments, more especially the fine adjustment, has scarcely been alluded to, but this is the most important adjustment of the instrument. I am of opinion that the original form of a micrometer screw and a lever has never been equalled by the more elaborate cams recently introduced. The smaller the number of parts that go to make the mechanism, the fewer the points of contact or bearings to give that slight sag at the reversal of the motion which makes it so difficult to obtain the best focus with high powers.

As to the form of a microscope, its stability does not depend upon whether the base is of the tripod or so-called horseshoe pattern. It is universally admitted that it should stand on three points, and the test of stability that should be applied is, at what angle will it upset, and what force is required to make it do so.

Some tripods are more unsteady than some of the horseshoe-pattern stands, and *vice versâ*. It is merely a question of the position of the three points on which the instrument stands compared with its centre of gravity and weight. As probably nine-tenths of the small compact microscopes sold are of horseshoe and pillar pattern, it may be concluded that an overwhelming opinion exists in favour of this type for ordinary botanical and medical work. This is probably because the substage is rendered more accessible, and the stability produced by a heavy base is preferred in a compact instrument to that obtained by a lighter stand with a greater spread to the feet, which also occupies a larger space. The large tripod base as supplied on some of the best research microscopes is probably the most perfect stand for stability, but the lateral legs are more or less in the way of the manipulation of substage apparatus. The design of the mechanical stage is an illustration of the necessity of specialised stands for different classes of work. If the mechanical stage is incorporated in the instrument its travel is greatly limited, as it fouls the condenser or the large illuminating

apparatus required for dark-ground illumination. No one who works with serial slides or large blood films can put up with the small amount of motion which suffices for examining a minute drop of fluid. The examination of large culture plates is also difficult if the mechanical stage is not removable. Mr. Barnard has pointed out that the adjustable object-glass holders cannot, and are not intended to, replace the centring adjustment of the substage condenser. Such a suggestion surely originated from one who had never tried to centre his light in this manner. The centring of the substage condenser is considered by many at the present time to be an unnecessary refinement, and for those who are content to use such a badly corrected appliance as the so-called Abbe condenser it may be so. It is to be hoped that the proper use of a well-corrected achromatic condenser will be more widely appreciated in the near future, and we shall hear less criticism of the so-called dilletanti to whose labours the perfection of the instrument is largely due.

Amongst the minor points that have been raised, I noted with interest the suggestion that the mirror should be fixed in the optic axis. No doubt the mirror is seldom, if ever, used out of the axis, but it should not be overlooked that to be able to swing it entirely to one side for changing the apparatus in the substage or for taking the illumination direct from the source of light is a great convenience. It is rather surprising to see such stress laid upon a large body-tube as preventing internal reflections. I know of no optical instrument in which a large tube is supplied for this purpose, for the very good reason that the reflections are much more efficiently stopped by a series of diaphragms in the tube. There is no virtue in a large body-tube when it has within it a small draw-tube extending almost its whole length. The object of the large tube is to enable low-power photographic lenses to be placed in it when wide-angled views of large objects are required, the draw-tube at one end and the nosepiece at the other being removed for the purpose.

As an English manufacturer I am not prepared to discuss the opinion that is said to exist in some quarters that Continental instruments are more suitable to scientific needs than those made in our own country. I would merely ask that if any hold this opinion they will patriotically assist the industry by letting the British maker have an exact specification of their requirements, and I believe they will find us at least as adaptable as any in meeting their wants. CONRAD BECK.

68 Cornhill, London, E.C.

I HAVE read with much interest the letter from Mr. Barnard on the above subject, which appeared in NATURE of January 25. Being the writer of the third section of the article which appeared in NATURE of December 21, I should like to reply to several points raised by Mr. Barnard contradicting some of my statements.

In the first place, it must be mentioned that Mr. Barnard takes certain statements as inferring far more than they are meant to, or do, imply.—There is nothing in my statements to imply "that the present-day English microscope is a degenerate form of what was originally a complicated and massive piece of mechanism." I stated it was a *simplified* form of its predecessors—a virtue indeed, therefore an advantage over the old English type.

I still maintain that the Continental instrument, having evolved from an exceedingly simple design, is a more highly satisfactory instrument. It is obvious that Continental makers have copied many ideas from the English, but it is equally obvious that the English makers have copied the Continental in many respects. If we compare the current catalogues of the principal makers in all countries where microscopes are constructed, it would be exceedingly difficult to define nationality in regard to design. Perhaps the least said respecting the country of origin the less likely one is to offend possible feelings of patriotism. The subject before us, however, is the question as to whether the English or the Continental microscopes are the superior, and in the article referred to I have dealt with the instruments as they are generally produced at the present day.

As regards the base, it is generally admitted that the horseshoe form is more convenient for the average worker than is the tripod, mainly on account of his having to employ the instrument more frequently in the vertical position; therefore a well-designed horseshoe, or modified horseshoe, as is generally found in the leading Continental stands, serves the purpose equally as well as the tripod. Only when the instrument is placed in the horizontal position does the tripod prove superior as regards rigidity.

The microscope is very rarely used horizontally, excepting in photomicrography, a work which does not concern the average microscopist; consequently, the greater rigidity in the tripod base is of no practical advantage. In other words, it is similar to making a 40-foot ladder to reach a height of 20 feet. Even when the microscope is considered for photomicrography, there is no practical advantage in the tripod over the horseshoe. (In the term horseshoe, I wish it to be understood that the models which Mr. Barnard mentions as having no rigidity or firmness in any position are excluded from the argument.) If the tripod base is not screwed or clamped to the photomicrographic apparatus, or held in position by other means, it cannot possibly remain in proper alignment for any length of time. Having occasion to use both the horseshoe and the tripod base in photomicrography, I fail to find any difference in respect to rigidity when the stand is securely fixed in position. When vibration was purposely set up I failed to observe it less in evidence in the microscope with the tripod base.

In the case of the tripod, I have it securely fixed in position by three carefully fitted recesses in the base-plate of the photomicrographic apparatus, and when the microscope is removed for visual work it can be easily and quickly returned to position for a photographic record to be made. On the other hand, the horseshoe base is securely clamped down on the base-plate, and thereby the two pieces of metal form, as it were, a solid mass. Provision is also made for quickly and accurately replacing the horseshoe upon the photomicrographic apparatus.

If the instrument built upon a horseshoe base was constructed of light or springy material, I could understand Mr. Barnard's contention that "the instrument is under considerable strain and tension."

In regard to the substage and the question of centring condenser *versus* centring objectives, Mr. Barnard's remarks amount to an admission as to the imperfect construction of the instruments he has employed. Such remarks would cause a careless or otherwise incapable mechanician to heave a sigh of relief in the expectation of the inferior workmanship that would evidently be accepted. The statement refuted by Mr. Barnard is that greater accuracy is obtained, especially in photomicrography, by having centring screws controlling the objectives instead of the substage condenser.

I cannot look upon the substage condenser of a microscope as being "an independent optical system carried on a separate part of the instrument and extremely difficult to ensure accurate alignment," but rather that it forms part of the system. In the best Continental instruments the dove-tail groove carrying the substage is formed out of the solid metal which constitutes the limb; that is to say, the limb of the microscope supporting the body-tube, coarse and fine adjustments, is carried down below the stage, and also supports the stage and substage fittings, therefore, is made out of a solid piece of brass giving the utmost strength and rigidity. When it is possible for the mechanician to provide accurate alignment in the body-tube for the highest power objectives, surely, then, it is less difficult to provide substage mechanism to carry a condenser, "even of the finest construction, which does not focus within such narrow limits." Continental microscopes are provided with substage mechanism in accurate alignment, and maintain alignment equally as well as the mechanism carrying the body-tube. Considering that condensers do not focus within such narrow limits as objectives, it is a less difficult task to adapt a series of condensers to the optic axis. Consequently, the substage condenser and the eyepiece become two fixed points in the optic axis of the microscope. As the leading makers provide objectives so well centred that the differences are but slight, the adjustments in the objective sliders effect all that is necessary to obtain the most accurate centration.

and with a considerable saving of time and trouble. Once the position of the substage condenser is altered the whole system of illumination from the substage condenser to the source of light is displaced, which must again be adjusted, so that we have to effect centring at various points on the optical bench. This is entirely avoided by having the substage condenser supported in a fixed sleeve, and the centring screws attached to the objectives or the nose-piece.

As regards the draw-tube, the point is that the use of the mechanical draw-tube is advocated more in England than are the correction collars, but *vice versâ* on the Continent. When one is using an objective without correction collar, which is extremely sensitive to differences in thickness of cover glasses, it is not at all necessary to resort to a mechanical draw-tube if one's instrument is fitted with a carefully made simple draw-tube as is generally provided in the best Continental stands.

It may be mentioned, however, that still better results would be obtained by resorting to the use of a cover-glass gauge, an instrument which is very valuable and inexpensive, but rarely used by workers. In dealing with the standardisation of the microscope, the matter of cover glasses, which is a serious one, should also be considered with the view of providing microscopists with covers of much more uniform thickness.

Mr. Sutcliffe, in his letter which appeared in NATURE of January 18, asks if there is any evidence obtainable that the English instrument has lost its premier position. We have not far to seek the necessary information, and when the facts are known we cannot consider the English instruments "degenerate," as the present models are much superior to their predecessors. The best English microscopes are a credit to any well-organised manufactory. The Germans, however, have advanced further in the direction of providing more perfect instruments, which are produced in works better organised and with more highly scientific arrangements.

The instruments that combine in the highest degree simplicity, efficiency, and durability are the most valuable to the serious workers, and these features are strongest in the best Continental microscopes.

I do not believe any amount of discussion would bring us to a decision so satisfactorily as a close examination of instruments which have been in use for a number of years in the principal laboratories throughout the world. In fact, we need hardly look outside our own little island for the result, as there is plenty of material at home to deal with for a settlement of the dispute in a most practical manner.

J. W. OGILVY.

18 Bloomsbury Square, London, W.C., January 30.

The Mnemic Theory of Heredity.

IN a review of the third edition of Prof. Richard Semon's well-known book upon this subject, in NATURE of January 18 (p. 371), the reviewer writes as follows:—"The mnemic theory, which is based upon a belief in the inheritance of acquired characters, naturally does not appeal to those who deny the possibility of such inheritance." From the point of view of modern embryological research, both of these statements are open to challenge. The founder of this mnemic theory, or "memory as a general function of organised matter," has indeed written very little upon the subject, which he first broached in a public lecture in 1870. At the date named, when Prof. Ewald Hering, now of the University of Leipzig, gave his classic address, I imagine that the question of the inheritance or non-inheritance of acquired characters had hardly been raised. By a curious coincidence, it was in the same year that Prof. W. Waldeyer in his researches set up the doctrine of the somatic origin of germ-cells from the "germinal epithelium," and obviously this doctrine of the somatic or bodily origin of germ-cells is demanded by the view of an inheritance of acquired characters. The history of embryological research upon the germ-cells during the present century demonstrates clearly that in his researches in the lower vertebrates the writer first established—in 1900—an actual tangible continuity of germ-cells from generation to generation, and the absence of any genetic connection between Waldeyer's "germinal epithelium" and the germ-cells, that in many other cases these find have been, and are still being, confirmed by the investigations of other observers, and that Prof. Waldeyer himself some years ago withdrew his former researches in favour of such a continuity of germ-cells as underlying the life cycle. Indeed, he wrote:—"The consequences of this doctrine of the continuity of germ-cells are almost incalculable for every branch of biology"; so that now for animals a fundamental postulate of the doctrine of an inheritance of acquired characters has vanished.

But, as a fact, the inheritance of acquired characters is more a botanical doctrine than a zoological one. In plants this apparent inheritance of such characters is confined to *the asexual generations*, in which, if the term "individual" be used, it must apply to *all the products*, asexually produced, of one original plant—that is, in this sense they would all form a single individual. As an instance, in this way all the countless plants of the white chrysanthemum, Niveus, would form a single individual. The doctrine of an inheritance of acquired characters does not, and cannot, apply to *the sexual generations of animals*. Moreover, here it is refuted by the positive finds of embryology, which demonstrate, under an actual continuity of germ-cells from generation to generation, that nothing at all is handed on from parent to offspring. As this is the case, nothing acquired by the parent can be inherited. That is, there is in the sexual generations of animals no such thing as an inheritance of acquired characters.

I do not now remember when I first came to know of Prof. Hering's theory of heredity as based in the unconscious memories of germ-cells, but it must be a long time ago. As Samuel Butler remarks of Charles Darwin and the doctrine of natural selection, it must have become an "unconscious memory" to me, for in my researches into the history of the germ-cells I evolved it anew. As showing this, and as affording a simple statement of the main lines of the theory, I may quote the following, written by me in 1904:—"From its nature it (the theory of heredity advocated by me) might be termed 'the Understudy-Theory of Heredity.' Given in a certain life-history the period of formation of the primary germ-cells. Of these let there be, for simplicity, but two, AB and BA. On one of these falls the lot of developing into an embryo; to which of the two this happens is not of consequence for the argument. In all its essential characters the remaining primary germ-cell (whose immediate destiny it is to become the founder of the 'sexual products' of the said embryo) is the exact counterpart of the developing one. So much so is this the case that, if both form embryos, these are identical twins. In the ancestry neither of the primary germ-cells, AB and BA, had ever been a higher animal; neither they nor their ancestors had ever formed part of the body of a higher animal. But their ancestry is continuous with a long line of germ-cells, and at regular intervals these were exactly like certain sister-cells, which did develop and form higher animal individuals. Although the cell AB does not itself give rise to an embryo, in the meantime it retains for itself, and also for all its immediate progeny, the properties of BA, those characters or potentialities which, were it or any of its progeny to develop, would make it or them identical twins with BA, the other cell which did develop. *This is the greatest wonder in embryology!* In the drama of heredity there are always understudies, which for a certain essential period are endowed with all the identical properties (potentialities) of that germ-cell from which the player arises. These understudies, the primary germ-cells, are never employed upon the stage as such—except in the instances of identical twins, triplets, &c.—but some of them in new guises and after new conjugations or unions are the immediate ancestors of those which become the acting characters in new scenes of the cyclical drama of Life."[1]

The original German of Prof. Hering's lecture, like Austrian German in general, is difficult, and probably the original is little known in this country, although an excellent translation was published in Butler's "Unconscious

[1] Beard, J., "A Morphological Continuity of Germ-Cells as the Basis of Heredity and Variation," in *Review of Neurology and Psychiatry*, vol. ii. 1904, p. 141.

Memory" (1880, new edition 1910). To me, as an advocate of this theory of heredity, it comes as something new—and strange—that underlying it there should be the assumption of an inheritance of acquired characters. I would rather conclude that, like Francis Galton, this illustrious physiologist—with the "prevision" of which Pasteur so often spoke—foresaw that the individual was not at all "a chip of the old block," but that at the basis of all development there was a continuity of germ-cells. For on p. 17 of Ostwald's reprint of the original lecture Prof. Hering writes:—"From this point of view the whole individual development of a higher organised animal forms a continuous chain of memories of the development of that great series of beings whose final link this animal represents."

Like the late Samuel Butler, the writer rediscovered this theory of heredity, and except that author he was the first to advocate it, upon grounds of observation, in this country. As undoubtedly it is of all theories of heredity *the theory* which is capable of accounting for and explaining all the facts, I venture to ask the courtesy of the insertion of this brief account of it in your pages. In the light of this overwhelmingly important theory the "Mendelian discovery," for example, sinks into its proper place as a small but interesting episode in the history of heredity.

J. BEARD.

8 Barnton Terrace, Edinburgh, January 22.

I AM unable to agree with Dr. Beard that the mnemic theory of heredity does not involve acceptance of the doctrine of the inheritance of acquired characters. Certainly the theory as enunciated by Prof. Semon, which formed the subject-matter of my review, is based upon such acceptance, to justify which weighty evidence is brought forward. Can an organism, or a germ-cell, be said to remember events of which it has had no past experience, direct or indirect? If, as Dr. Beard holds, neither the primary germ-cells nor their ancestors have ever formed part of the body of a higher animal, can they be supposed to remember events in the ancestral history of the race, unless, of course, they have received information as to such events (engrams) from the bodies in which they are, or were, enclosed? The power of transmitting such engrams to the germ-cells is the fundamental conception of the doctrine of the inheritance of acquired characters, as it is also of the mnemic theory as expounded by Prof. Semon. If, however, Dr. Beard holds that the germ-plasm does not receive engrams from the body at all, but is merely a continuous stream of living matter which has the power of producing some particular type of body at intervals and under appropriate conditions, I fail to see where the idea of memory comes in, any more than in the case of the periodic waves produced by the tide.

I cannot see that the doctrine of the somatic or bodily origin of the germ-cells has any necessary connection with the doctrine of the inheritance of acquired characters. Even if we adopt the opposite doctrine, that the germ-cells form a continuous chain from generation to generation and are separated from the somatic cells at the very commencement of individual development, such a view does not seriously affect the question, for there is no valid reason for supposing that the germ-cells could be influenced by the somatic cells only through some protoplasmic connection.

Again, why should any distinction be drawn between plants and animals with regard to the problem under discussion? It would indeed be strange if the two great divisions of the organic world should differ in this respect. Of course, in the higher plants, the sexual generation (gametophyte) is very greatly reduced, but none the less a true sexual process intervenes between each asexual (sporophyte) generation and the production of the ripe seed. The case of the peach trees quoted in my review is in no way comparable to Dr. Beard's chrysanthemums, for the embryo plant within the seed is developed from a fertilised egg as truly as in the case of any animal. It is obvious, moreover, that in the case of the higher plants Dr. Beard's view as to the relations of the germ-cells cannot be maintained, for the whole sporophyte generation intervenes between each two successive sexual generations, and the latter develop each from a single non-sexual cell, the spore, produced by the sporophyte generation after it has attained maturity. Here, at any rate, there is no continuous chain of germ-cells distinguishable from somatic cells.

Dr. Beard's views on the subject of identical twins are new to me. I was under the impression that such twins were supposed to result from the complete division of a single fertilised ovum. This, at any rate, is the view adopted by Weismann.

ARTHUR DENDY.

The "Isothermal Layer."

I AM inclined to doubt whether Commander Hepworth's suggestion (NATURE, January 25) that the so-called "isothermal layer" is simply due to radiation from the material, solid or gaseous, which circulates round the sun with an orbital motion and gives rise to the zodiacal light, can be reconciled with the configuration of the surfaces of equal temperature in the upper air which show a progressive increase of temperature from low to high latitudes. It seems more probable that this increase, and the fact that above a certain height in these latitudes the temperature no longer diminishes with the altitude, are the result of the prevalent movement, outside the equatorial belt, of the higher portion of the atmosphere from west to east with comparatively great velocity, which increases with the latitude and altitude, and extends to lower levels as the distance from the equator becomes greater. This movement, which gives the upper atmosphere greater angular velocity than the lower and the earth beneath, partially counteracts the force of gravity and causes the air to rise and expand without doing work, and therefore without suffering a decrease in temperature. At the equator there appears to be no satisfactory evidence of an "isothermal layer."

But although the radiation from the orbital interplanetary matter of the zodiacal light may not afford an explanation of the "isothermal layer," it must be taken into account as a climatic factor. Maurer has shown that the earth receives at night radiated heat to the extent of 0·37 of a calorie per square centimetre per minute. This is attributed—no doubt in the main correctly—to radiation from the carbonic acid and water vapour of the atmosphere, but some portion must have an external source. It is possible that the radiation from interplanetary material may at present be almost as inconsiderable as that from the planets or the fixed stars; but if, as we have every reason to believe, there has been a gradual approximation of this diffused orbital matter towards, and absorption in, the sun, there must have been a time when so much was present beyond the earth's orbit that the radiation received from it balanced to a considerable extent the radiation from the earth into space, and rendered not only the daily and seasonal variations of temperature, but also the permanent differences of temperature between high and low latitudes, much less marked than they are at present.

I have for some time thought that it was in this direction we ought to look for the explanation of the comparative uniformity of temperature that appears to have prevailed in different latitudes in Palæozoic times, a uniformity that seems to have existed as much in periods of cold as of high temperature, and the absence of marked seasons even in the far north, evidenced by the fact that the remains of stems with exogenous growth show little or no trace of annual rings. In the long Arctic night, not only heat, but light, would have been continuously received from this source. How considerable, even at present, is the illumination given by the zodiacal light can only be realised by those who have travelled in moonless nights in the tropics. Even in forest country with a cloudy sky the darkness of midnight is changed about 2 a.m. to a twilight, which is quite sufficient to render the track visible until the true dawn appears.

Nordenskiöld has given reasons for believing that fine cosmic dust revolves round the earth itself as centre. If this be the case, its climatic influence in the past may have been similar, but it was probably of much less importance.

JOHN W. EVANS.

January 27.

Are Eyes ever Autophanous?

I venture to suggest the following simple explanation of the phenomenon described by Colonel Herschel in Nature of January 18. At the distance at which his experiments were made the light from the lantern or other source enters the lens practically as a pencil of parallel rays, which is concentrated as a bright spot on the retina. The divergent light from this bright spot, which passes backwards through the lens, is again made into an almost parallel pencil. If the retina is exactly in the focal plane of the source of light, and the image an absolutely sharp one, the whole of the light is again concentrated on to the bull's-eye of the lantern, and without the use of a transparent, but partially reflecting, surface, it must be impossible to see it. But the least blurring of the image, from whatever cause, leads to a slightly divergent pencil, which, however, is still narrow enough to concentrate the returning light within a degree or so from the direction of the original source. To an observer within this cone of rays the bright spot on the retina will appear to fill a part or the whole of the pupil, just as a black dot may be made to fill the whole aperture of a lens to an observer at a distance by holding the lens at its focal distance from the point in question.

A cat's eyes when in shadow may often be seen by a watcher, himself in the light, to be filled with a faint luminescence, which disappears when the watcher's own eyes are shaded. The source in this case must be the bright surface of the face of the observer, possibly combined with the reflected point or points of light on the *external* surface of the observer's eyeball. The phenomenon is rather a curious one, and may account for a certain number of the cases in which an animal's eyes are supposed to be autophanous. E. M. Anderson.

Edinburgh, January 27.

Chalk and Ice.

Two nights of hard black frost, following upon the recent wet weather, has resulted in pieces of chalk resting upon a wet clay soil becoming curiously coated with ice. This occurs only in the case of chalk, other stones—except fragments of brick, which have a thin veneer of ice on them—and lumps of clay being free from it.

A piece of chalk 2 in. × 2 in. × 1 in. embedded in the soil is covered with ice as in Fig. 1. The ice is fibrous. Small pieces of chalk give forms as in Fig. 2. The central figure evidently illustrates two nights' growth, the upper

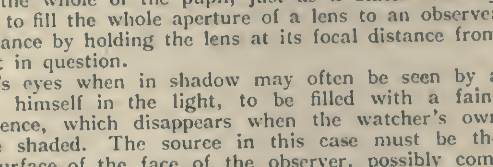


Fig. 1.

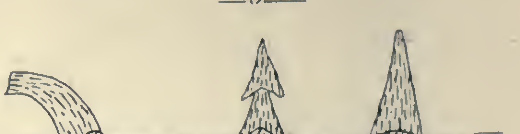


Fig. 2.

cone having been thrust off the chalk by the growth of the one below.

The moisture has evidently frozen on the chalk, fresh moisture rising from the ground and passing through the chalk, thus keeping up the supply. The chalk itself is not frozen, and can be broken easily by hand, but the pillar of fibrous ice is firmly frozen to it.

We also noticed tooth-like pieces of ice projecting from the lawn, and in every case these were found to rest on pieces of chalk beneath the surface. An examination of the flower beds revealed bosses of ice coming up through the soil, the ice in all cases resting on lumps of chalk beneath the surface. The rising water in the chalk tends to prevent the latter freezing, the cold spending itself in producing the ice resting upon the chalk.

It is conceivable that a stratum of stones and clay, resting upon chalk, might in a severe climate become separated from the chalk by an ice layer. The formation of ice below the surface in this way may account for the "soil creep" which has occurred in the past, and the effects of which are now so noticeable in chalk districts.

R. M. Deeley.
D. Deeley.

Inglewood, Longcroft Avenue, Harpenden.

Glazed Frost.

The deposit of "glazed frost" sometimes attains remarkable thickness in Newfoundland, and the great weight of ice formed causes considerable flexure of even thick branches of trees.

I have seen every twig and every blade of grass duplicated on the windward side in clear ice, the ice "twig" often having a diameter two, three, or even more times that of the twig on which it was formed.

Thick slabs of ice appear on the windward sides of tree trunks, palings, and even of walls. In Newfoundland the rain is often followed by bright sunshine, when the effect is most beautiful, and is aptly described in the local name "silver thaw." The explanation of the phenomenon, quoted from "The Observers' Handbook" in Mr. Harding's letter to Nature of January 25, would seem to be justified by the *thickness* of the deposit formed on twigs and on blades of grass; it would be difficult to account for a *thick* deposit of ice if the raindrops were not supercooled before touching the trees or ground.

E. R. Marle.

Hartley University College, Southampton, January 29.

The Thawing of Frozen Water Pipes.

As the present frost is causing serious inconvenience in many houses, I should like to direct attention to a method of thawing ice in pipes which I have frequently put into practice and found effective. It is based on the principle that strong brine eats its way into the ice like an acid, and that the resulting diluted brine rises and makes room for the denser fluid. Close the main tap, and with a spanner unscrew the top of the valve of the frozen water-pipe and remove the small valve. Ball taps to cisterns may have to be unscrewed altogether. Insert a few feet of one-eighth inch rubber or lead tubing into the pipe, and pour concentrated brine into it through a small funnel. Replace the valve and cover, but leave the valve open; also open the main valve, and wait. If the ice plug in the pipe is only 1 or 2 feet long it will have been eaten through in about an hour's time; if longer, the above operation should be repeated several times. The brine is prepared by boiling an excess of salt in water, say half a pound per pint; it should, if possible, be used hot, and renewed frequently.

West Didsbury, February 5. C. E. Stromeyer.

The Names of Fossil Plants.

Every botanist must agree with Dr. Marie Stopes that there should be some ready way to distinguish between the fossil plants which are referred with reasonable assurance to their genera, and those which are merely placed in genera which they seem to resemble, but to which they very probably do not belong. We must also agree that it is unsatisfactory to call every doubtful leaf "Phyllites," without any serious attempt to indicate its affinities. The use of Gothic type, suggested by Dr. Stopes for the doubtful genera, has some disadvantages, one of them being the inconvenience to the printer. Would it not be simpler to use quotation marks, in the case cited by Dr. Stopes writing "*Ophioglossum*" *granulatum?* The generic name only should be enclosed within commas, as it alone is supposed to be in doubt. The method proposed has the advantage of being already more or less current and readily understood by any reader.

T. D. A. Cockerell.

University of Colorado, Boulder.

THE PEOPLE OF SOUTH CENTRAL CONGOLAND.[1]

MR. HILTON-SIMPSON'S interesting book is a valuable supplement to the monumental work recently published by the Colonial Department of the Belgian Government on the "Ethnography of the Bushongo and Allied Peoples," a work written in French by Mr. Emil Torday, the celebrated Hungarian explorer, and Mr. T. Athol Joyce, of the British Museum. The Torday-Joyce contribution to ethnology adopted necessarily a somewhat impersonal aspect, and the work of Mr. Hilton-Simpson now gives us a more popular and personal account of the expedition so ably organised by Mr. Emil Torday. At the same time, though the "Land and Peoples of the Kasai" may be described as "popular" in style, it is fraught with scientific interest. It contains many valuable illustrations, "prises sur le vif," the untouched photographs of the author, besides the beautiful and accurate drawings in colour by Mr. Norman Hardy, who accompanied the expedition during the first half of its stay in Congoland. Amongst these last must be mentioned with special praise for their artistic charm as well as their absolute accuracy, "Wissmann Pool" and "An Incident at Pana" (a charging buffalo).

The party of which Mr. Hilton-Simpson was a member arrived at Boma, the capital of the Independent State of the Congo, at the close of 1907. Here they had to visit the offices of the Etat Civil, where they filled up "matriculation" forms dealing with their ages, their occupations, and the dates of their parents' birth, and other "such matters of great interest to the authorities," who in the Congo State still too often belong to that narrow-minded bureaucratic class which is rapidly becoming extinct in Germany, Holland, and France. Nevertheless, the Belgians gave the kindest and most whole-hearted assistance to Mr. Torday's expedition. Their mission was officially recognised by the Government; they were spared all hindrances and given all due protection. And when it is remembered that their avowed object was to collect for the British Museum, and they came at a time when English public opinion, with much justification, was showing great indignation with the Leopoldian *régime*, it must be admitted that the Belgian authorities on the Congo knew how to rise above considerations of narrow nationalism and to remember that they were there to govern a State which at that period was still international in its avowed character.

From the Lower Congo the party was conveyed by railway and steamer to the Kasai. This river at once contrasted with the main Congo by "simply teeming with hippopotami, crocodiles, and innumerable varieties of aquatic and other birds"; for owing to some unexplained reason the destruction of animal life along its banks had been very little compared with the devastation which has fallen on the main Congo through the acquisition of guns by the natives and the thirst for killing which has so long animated all white pioneers, settlers, and steamer passengers in that region. An interesting description is given of the headquarters of the Kasai Company at Dima, near the confluence between the Kasai and the Kwango (the Kwango was the first of the great Congo tributaries which entered into history, and was reached by the Portuguese as early as the seventeenth century, though its lower course remained unexplored

FIG. 1.—Head of *Bos caffer simpsoni*. From "Land and Peoples of the Kasai."

and mysterious down to the close of the nineteenth century). It is interesting to note that at Dima, as elsewhere in the Congo, Belgian enterprises are obliged to have recourse to the employment of educated British negroes from West Africa—Sierra Leone, the Gold Coast, and Lagos. Here is a sufficient answer to the ignorant folk who sneer at the education of the negro. As a matter of fact, public education in the British West African colonies is far too much neglected by the British Government, especially in the Gold Coast. If it were improved, there is no saying how far it might not extend British influence and the spread of the English language throughout West and Central Africa.

The party continued its journey up the Kasai, noting on the way an extraordinary epidemic of

[1] "Land and Peoples of the Kasai." Being a narrative of a two years' journey among the cannibals of the equatorial forest and other savage tribes of the south-western Congo. By M. W. Hilton-Simpson. Pp. xx+356. (London: Constable and Co., Ltd., 1911.) 16s. net.

disease which had broken out amongst the hippopotami on the Kasai and Sankuru. The loss of life amongst the hippopotami had been so great that the Europeans had been obliged to employ men with canoes to push out into the current the carcases which were continually being stranded on the shores of the river, the stench from which was appalling. Then follows a description of the Sankuru and the marvellous forests on its banks, its red, rocky cliffs rising in places to a height of 200 feet, in the crannies of which nested innumerable grey parrots. The mysterious yuka referred to by the author as a tree-dwelling nocturnal beast uttering a weird cry was probably a tree-hyrax.

The Basonge, the Batetela (and their love of painting pictures and use of signalling gongs), the Bakongo of Central Africa (not to be confused with the quite distinct Bakongo of western Congoland), the cannibal Bankutu, the Batwa dwarfs, the Batende, Babunda, Baluba, Basongomeno, and, above all, the aristocratic Bushongo, are most interestingly described.

FIG. 2.—An Akela cutting up his food. From "Land and Peoples of the Kasai."

The Batwa dwarfs seem to have varied from four feet eight to five feet in height (a photograph is given of them). The journey through the Bankutu cannibals was not devoid of risk; the travellers owed their safety probably to the curiosity excited by their presence without an escort, yet well supplied with means. On p. 147 an accurate and very effective description is given of the "airlessness," disheartening mist, and excessive damp, of the dense forest. "In the daytime the atmosphere of the woods resembles that of a hothouse; at night that of a well."

The zoological discoveries of the expedition due to the author of this book, consisted mainly of a new species of very small duyker antelope (*Cephalophus simpsoni*), and an interesting transitional type of buffalo, a subspecies also named after Mr. Simpson, which differs from the dwarf buffalo of the Congo in being black-haired (chocolate in the females) and not reddish-brown, and in having horns set much wider apart than those of *Bos caffer nanus*. The bosses of the horns in the male are almost completely joined over the forehead.

Mr. Hilton-Simpson's photographs of the negroes of South-Central Congoland will be of much interest to anthropologists and ethnologists. Although mostly small, it is evident that many of them would bear enlargement and prove very useful to the picture galleries of museums.

H. H. JOHNSTON.

THE EFFECT OF GRASS ON FRUIT TREES.[1]

AMONG the many interesting results obtained at the Woburn Experimental Fruit Farm perhaps the most remarkable is the discovery that growing grass exerts a deleterious effect on fruit trees. This was one of the earliest observations, and was dealt with at some length in the third report in 1903, but a number of experiments have since been made, and are described in the thirteenth report recently issued.

The general result of grassing the ground after the trees have been planted is the arrestation of all healthy growth and the absolute stunting of the tree. The leaves become light in colour and unhealthy, the bark similarly becomes light coloured, while the fruit loses its green matter and becomes waxy yellow or brilliant red. This effect is particularly marked in the case of apple trees. If the grassing is done gradually the trees accommodate themselves somewhat to the altering conditions, and finally make growth and yield fruit, though they never do so well as when grass is absent.

A number of hypotheses have been examined to account for these phenomena. The grass roots affect the aëration of the soil, the amount of carbonic acid present, the soil temperature, moisture, food supply, &c., and they may, as the United States Bureau of Soils claims, excrete poisonous substances. The earlier investigations showed that neither the aëration nor temperature effects played any part in the matter, so far at least as tree growth is concerned; the present experiments are therefore directed to the investigation of the other factors. Several results proved that the harmful effects on the trees were not due to any abstraction of moisture by the grass. The affected trees exhibited none of the signs of suffering from drought or of recovery during wet seasons, while determinations of the water content of the grass and tilled soil at intervals throughout a year revealed no differences sufficient to account for the effects. Still more conclusive evidence was obtained by growing trees in pots, some with, others without, grass, and keeping all equally moist; the deleterious effect of the grass remained equally marked.

It is more difficult to test the effect of grass on the food supply of the tree, because our knowledge of what constitutes the food either of fruit trees or of grass is still far from complete. Pot experiments with the ordinary nutrient substances all led to negative results, and the conclusion is drawn that the effect on the food supply is not the determining factor.

Nor did it appear that the growth of grass caused any sufficient physical alteration in the soil to account for the results. There remains only the hypothesis that plant roots excrete some substance toxic to the tree roots, and for this the authors claim to have a fair amount of indirect and some direct evidence. When perforated trays of sand containing growing grass were placed on the surface of the soil in which the trees were growing, so that the washings from the grass reached the tree roots with practically no exposure to the air, they had a deleterious effect nearly, if not quite, as great as when grass was

[1] Thirteenth Report of the Woburn Experimental Fruit Farm. By the Duke of Bedford, K.G., F.R.S., and Spencer U. Pickering, F.R.S.

grown above the roots of the tree in the ordinary way. The conditions of the experiment seem to have precluded any sufficient contact of the grass roots with the tree soil to allow of the abstraction of plant food, and, if the result is confirmed, it is difficult to avoid the conclusion that the grass roots have actually excreted a toxin.

As already stated, the United States Bureau of Soils has long upheld the view that plants can excrete toxic substances, but it has been generally supposed, in this country at any rate, that the experiments of Daubeny and others put the hypothesis out of court. But Mr. Pickering has discovered an important property which the toxin (if it exists) must possess; it is extremely transient, and disappears very rapidly from the soil. No toxic effect can be detected in soil removed from round grass roots, while even the washings from the trays above mentioned failed to have any bad effect if they were exposed for a short time to air.

A very interesting problem has been thus opened up, the development of which will be watched with interest. E. J. R.

THE BIRDS OF HOMER.

THE advantages of the application of scientific knowledge to the literary problems of the Homeric poems are well illustrated by an article contributed to the second part of the "Journal of Hellenic Studies" for 1911, by Mr. J. Maclair Boraston on "The Birds of Homer." He remarks that "whether in the form of epithet or by special description, Homer's portrayal of birds deals chiefly with essentials. In this lie the advantage and disadvantage of the Homeric method for one whose main purpose is concerned with what in Homer was merely contributory to a fuller one. The advantage of such a method is that it forces essentials to the front, and the disadvantage, that the references to these may be limited by the nature of the matter they serve to illustrate; or that, being references to the characteristics of a class of birds, they may not suffice for the illustration of a particular member of that class."

Dealing first with what Homer calls "carnivorous birds," we find three mentioned, the first represented by the bearded vulture (*Gypaëtus barbatus*), the second and third including the cinereous vulture (*Gyps monachus*), the griffon vulture (*G. fulvus*), and the Egyptian vulture (*Neophron percnopterus*). The poet describes three eagles—"the high-flyer" and the "ruddy," both apparently Bonelli's eagle (*Hieraëtus fasciatus*) in mature and immature plumage, while the "morphnos" or "perknos" eagle, the "black" or "dark," and the "snatcher" are all names for the golden eagle (*Aquila chrysaëtus*). The general terms for the hawk or falcon include several birds—the goshawk (*Astur palumbarius*), the sparrow-hawk (*Accipiter nisus*), the peregrine falcon (*Falco peregrinus*), the lanner (*F. lanarius*), the saker (*F. sacer*), the merlin (*F. aesalon*), and the hobby (*F. subbuteo*). Two varieties of owl are identified with the scops (*Scops giu*) and the long-eared owl (*Asio otus*). Under gulls Homer refers to no fewer than eight varieties, all found at the present day in the Mediterranean. The "diving seabird" includes various kinds of terns, chiefly the common tern (*Sterna fluviatilis*). Under the head of cranes we find the common crane (*Grus communis*), and the demoiselle (*G. virgo*). Swans include the mute swan (*Cygnus olor*) and the whooper (*C. musicus*). Of geese we have the grey lag (*Anser cinereus*), the bean goose (*A. segetum*), and others. Among miscellaneous birds we notice the grey heron (*Ardea cinerea*); the jackdaw (*Corvus monedula*); the starling (*Sturnus unicolor* and *S. vulgaris*); the rock dove (*Columba livia*); three thrushes—the fieldfare (*Turdus pilaris*), the missel thrush (*T. viscivorus*), and the redwing (*T. iliacus*); the common nightingale (*Daulias luscinia*); the great titmouse (*Parus major*); and the ring-dove (*Columba palumbus*).

Mr. Boraston's article records a number of interesting details illustrative of bird-life in the Mediterranean, which will be welcome not only to ornithologists but to classical students, and a survey of the facts which he has collected tends only to increase our admiration for the genius and powers of accurate observation possessed by the greatest of the epic writers.

SIR JOHN DALRYMPLE-HAY, BART., G.C.B., F.R.S.

ADMIRAL THE RIGHT HON. SIR JOHN DALRYMPLE-HAY, Bart., G.C.B., F.R.S., was born in Edinburgh on February 11, 1821, and died in London on January 28. His naval career was commenced in August, 1834, and he was placed on the retired list in 1870, under Mr. Childers's scheme, having attained flag rank as Rear-Admiral about four years earlier, and having occupied various offices on shore after ceasing to command the line-of-battle ship *Indus* in 1859. His active service afloat, therefore, ceased in the year when our first seagoing ironclads were ordered. During the thirty-six years comprised in that service he had witnessed the change from sails to steam propulsion, serving nearly all the time in wood-built sailing ships, and having commanded, as captain, the *Indus*, which was the last sailing line-of-battle ship in seagoing commission. Sir John Hay was present at the capture of Acre by Sir Rupert Stopford, and later (1849) greatly distinguished himself by the destruction of a pirate flotilla in China. The latter service secured for him promotion to the rank of captain; and in 1855–6 he commanded the *Hannibal*, the flagship of Sir Houston Stewart, second in command of the Black Sea Fleet during the Crimean War.

When Kinburn was bombarded by the French ironclad floating batteries, Sir John Hay was present, and then obtained personal knowledge of the value of armour as a protection against the attacks of the most powerful naval guns and shell-fire available at that date. It was natural, therefore, that he should have been appointed chairman of the Iron-plate Committee which was established in 1860 to carry out experiments on armour, and to investigate the innumerable proposals and inventions submitted for adoption in the Royal Navy. In a period of rapid change and transition in naval *matériel* it was a wise step to appoint that committee, and to associate in its membership both distinguished officers and eminent engineers and men of science—including Sir William Fairbairn, Dr. Percy, and Dr. Pole—whose authority on questions of metallurgy and engineering was generally recognised, while their advice and assistance in the conduct of experiments and the analysis of results were of great value.

In his conduct of the affairs of this committee, Sir John Hay displayed great tact and marked ability, often in circumstances of considerable difficulty, inventors being both sensitive and ready to take offence when their proposals were criticised or rejected. Recognition of the value of his work came to Sir John Hay from technical and scientific societies; he was elected a vice-president of the Institution of Naval Architects in 1862, and a Fellow of the Royal Society in 1864. Throughout his long life Sir John Hay continued to take an active interest in both these societies, and in connection with the Naval Architects he played

a prominent part until failing health compelled him to retire. In the conduct of the business, as well as in the discussion of professional subjects, his ripe experience, sound judgment, and charming personal qualities had much to do with the successful development of the institution, the membership of which includes not merely naval architects and marine engineers, but naval officers, shipowners, yachtsmen, officers of the mercantile marine, and many other classes interested in or connected with shipping.

At the Royal United Service Institution also Sir John Hay did good service, and gave proof of his love for and acquaintance with many branches of science, as well as his desire to utilise all departments of knowledge for the improvement of the Royal Navy. In short, for a man born early in the nineteenth century, and employed at sea from a tender age until he had reached the prime of life, Sir John Hay was remarkable; and he may be fairly described as a pioneer in the class of scientific naval officers which has now become both numerous and influential.

Of his political career this is not the place to speak, but allusion may be made to his services as a Sea Lord of the Admiralty in 1866–8. Although the appointment of Sea Lords was then made largely on political as well as professional grounds, and his political future might have been seriously prejudiced by the independent action which he took in November, 1866, he refused to sign the Navy Estimates, and tendered his resignation because he considered the new programme of shipbuilding to be inadequate. This action showed the temper of the man, who, under a most pleasant and conciliatory manner, concealed great strength of character and readiness to act up to his convictions. His business capacity was considerable, he was a capable speaker, and an agreeable writer, as his books dealing with the naval service showed. He died full of years and honours, mourned by many friends; but some years of retirement, accompanied by blindness towards the end, had prevented him from being so much before the public as formerly. His work was done and well done, and many of its results will abide.

DR. A. H. KEANE.

WE regret to announce the death of Dr. A. H. Keane on February 3, after a long illness. He was born in Cork in 1835, was educated in Dublin and elsewhere, and completed his student career in Rome, finally taking his degree with honours in the Roman Catholic College in Dublin. Later he studied in Germany, and thereafter devoted himself to literary work, his first important book being a "History of the English Language" (1878). Shortly afterwards he taught English, German, French, and Hindustani at the Hartley Institute, Southampton, and subsequently a professorship of Hindustani was created for him at University College, London, which he resigned in 1885. After a short visit to the United States, he settled down in Hampstead, where he resided until his death.

Anthropology loses in Dr. Keane one of its most prolific and erudite students. His literary training and great command of languages predisposed him to collation and synthesis, as is proved by several excellent studies in the Journal of the Anthropological Institute; for example, "On the Relations of the Indo-Chinese and Inter-Oceanic Races and Languages" (1880), "The Botocudos" (1883), "The Ethnology of the Egyptian Sudán" (1884), "The Lapps" (1885), and others. He also contributed very numerous articles on ethnology to NATURE, *The Geographical Journal*, *The Academy*, *The Encyclopaedia Britannica* (ninth edition), *Chambers's Encyclopaedia* (1890–1), and *Cassell's Storehouse of General Information* (1890–94). Of more permanent value are his admirable monographs on Asia, Africa, Central America and West Indies, and South America in "Stanford's Compendium of Geography and Travel." Amongst other publications are "The Boer States, Land, and People" (1900), "The Gold of Ophir" (1901), and numerous translations, as, for example, "The Earth and its Inhabitants" (Elisée Reclus), "Peruvian Antiquities" (W. Reiss and A. Stübel), "The Science of Language" (Abel Hovelacque), "Philosophy, Historical and Critical" (A. Lefèvre), "Travels in Africa" (W. Junker), and "The Second Deluge" (J. Rodenberg).

But Dr. Keane's reputation will rest mainly on his "Ethnology" (1896), "Man Past and Present" (1899), and "The World's Peoples" (1908). The first deals with the physical and mental evolution of man, the antiquity of man, criteria of race, and the primary ethnical groups. The second is a masterly summary of the ethnology of all races and peoples, and is an indispensable book to all interested in such subjects. The third, as its subtitle explains, is a popular account of the bodily and mental characters, beliefs, traditions, and political and social institutions of the world's peoples; the numerous photographs add greatly to its value.

Dr. Keane was a typical library student, and being of retiring disposition, was rarely to be seen at scientific meetings. He had strong views and could express them with vigour, but he did not seek controversy. Although lack of opportunity prevented him from making any original investigations, the vast extent of his reading enabled him to marshal in an orderly manner the observations of other people, and often to throw a fresh light upon them.

A. C. HADDON.

NOTES.

WE regret to announce the death, on February 2, in his sixtieth year, of Dr. H. T. Bovey, F.R.S., formerly Rector of the Imperial College of Science and Technology.

M. BIGOURDAN has been elected president of the Paris Bureau des Longitudes for the present year. M. Baillaud becomes vice-president, and M. Andoyer secretary.

THE gold medal of the Royal Astronomical Society has been awarded by the council to Mr. A. R. Hinks, for his determination of the solar parallax from observations of Eros.

THE Canadian correspondent of *The Times* announces the death, at eighty-seven years of age, of Sir James Le Moine, who for many years was an industrious writer on historical and ornithological subjects, and in 1894 was elected president of the Royal Society of Canada.

REUTER'S AGENCY reports that two British officers, one belonging to the Survey of India, have been detached to locate the falls of the Brahmaputra, which are reputed to exist in the hitherto unexplored reach of the river which lies between Assam and the great bend of the river to the northward. Attempts have been made by native surveyors and others to locate these falls and to traverse this part of the river where its valley cuts across the great Himalayan chain, but so far without any success.

FURTHER evidence shows that, of the four reported earthquakes referred to in our last issue (p. 459), that felt in Glenfruin on January 26 was probably not of seismic origin. The shocks at Lennoxtown on January 20 and

Llanhilleth on January 26 were extremely local, and there can be little doubt that they were due in part to artificial causes. The Dunblane shock of January 28 was one of the series of earthquakes which have been so prevalent since 1905 on the south side of the Ochil Hills, possibly with its focus rather farther to the west than usual.

A CELEBRATION of the centenary of the Academy of Natural Sciences of Philadelphia is to be held on March 19–21. The publication of three volumes has been decided upon: a commemorative volume of scientific memoirs; an index to the series of Proceedings and Journal up to and including 1910, now amounting to nearly one hundred volumes; and a detailed history of the academy by Dr. Nolan. Delegates will be received and historical addresses will probably be delivered on the first day; two morning sessions will be devoted to the reading of scientific papers; and there will be a banquet on the evening of March 21, the official birthday of the academy.

WE learn from a communication received from the Decimal Association that the King of Siam, on November 15 last, ordered the adoption of the metric system throughout his kingdom at an early date. The authorities in Siam are in communication with the Bureau International des Poids et Mésures at Sèvres on the subject of the provision of standards and prototypes for furnishing a Central Office of Weights and Measures for the country. The Government stands pledged to the passing of a law introducing the system in about a year from now, which law, after an optional period of one year only, will be enforced throughout the kingdom.

PROF. A. S. HITCHCOCK, systematic agrostologist of the Bureau of Plant Industry, U.S. Department of Agriculture, who represented the Smithsonian Institution in the biological survey of the Canal Zone as a collector of grasses, has just returned to Washington. He estimates that he has secured about 150 species of grasses from the Canal Zone alone, and that, including the collections of Messrs. Pittier and Maxon, the National Herbarium will have as many as 200 species from Panama. This greatly increases the known species, and Prof. Hitchcock believes that he has from four to five times as many from this region as were previously known. Many of the species found in Panama were known previously only from Brazil and other regions of South America.

DR. L. A. BAUER returned to his office at Washington, D.C., at the end of December last, after a nine months' trip of inspection of magnetic work on board the *Carnegie*, and visiting magnetic institutions in the Pacific Islands, New Zealand, Australia, India, Burma, China, and Japan. Three positions as magnetic observer are to be filled in the Carnegie Institution of Washington at salaries ranging from 900 to 1500 dollars per annum and field expenses, according to training and experience, with possibility for further promotions as advancement is made. The duties imply assignment to magnetic survey work (determination of the magnetic elements), according to circumstances, either on land in foreign countries or at sea on board the magnetic survey yacht *Carnegie*. Applications, with full statements as to collegiate training and experience, and accompanied by references, should be forwarded immediately, and addressed to: The Director, Department of Terrestrial Magnetism, The Ontario, Washington, D.C.

IN the notice of Prof. Sollas's "Ancient Hunters" in NATURE of January 25, the reviewer assumed that as no reference was made to Mr. J. Reid Moir or his sub-Crag flints they were "rejected as convincing evidence of man's existence." Mr. Moir writes to suggest that the absence of mention of his implements from below the Crag is probably due to the chapter dealing with "Eoliths" having been written before the facts of his discovery were made public. We understand that the book was in print before Prof. Sollas had the opportunity of examining Mr. Moir's specimens, so that it is scarcely correct to assume that he has rejected them as evidence of man's workmanship.

THE discovery of a human skeleton beneath a stratum of Boulder Clay near Ipswich, and partly embedded in the underlying mid-Glacial sands, is likely to prove an event of considerable importance to those interested in the evolution of the modern type of Man. According to the somewhat sanguine report which appeared in *The Times* of February 1, Mr. J. Reid Moir and those who saw the remains *in situ* are confident that the overlying stratum of Boulder Clay ($4\frac{1}{2}$ feet in depth) was undisturbed, and that the remains are older than the deposition of the Chalky Boulder Clay, which marks the most severe of the various Glacial periods. If this proves to be the case, and no doubt Mr. Moir and those associated with him will place all the evidence before experts at an early date, the skeleton thus found will be the earliest remains of the human body yet found in England. The skeleton has been examined by Prof. Keith, who reports that in all its essential features it is of the modern type, with absolutely no trace of the unmistakable characters of Neanderthal man. Yet the period assigned to the Ipswich remains is long anterior to the Mousterian period to which the remains of Neanderthal man belong. To those who regard Neanderthal man as an altogether distinct form of mankind which persisted long after the modern type of man (*Homo sapiens*) was evolved, this discovery at Ipswich will cause no surprise.

THE study of plant diseases is so important from the technical point of view, and presents so many problems of scientific interest, that any suggestions for advancing it deserve serious consideration. The Biology Committee of the Agricultural Education Association is organising a card index that shall form a systematic record of fungus, insect, and other diseases of plants, and invites the cooperation of those able and willing to help in order that the record shall be as complete as possible. The value of the work, of course, will depend entirely on the extent to which this invitation is taken up. The record thus compiled will be available for consultation by any investigator, either by application to the secretary of the committee, Prof. J. H. Priestley, of the University of Leeds, or by application to the Board of Agriculture, which will hold duplicates of all the entries. The committee hopes to receive the cooperation of all investigators of this subject in the British Isles, and to form a record that shall not only be useful to the economic biologist, but also to the mycologist and to other students of plant diseases. Full information about the scheme can be obtained from Prof. Priestley.

IT is stated by *The Times* that the Daylight Saving Bill is to be brought forward again next Session, and its supporters hope that a member who obtains a good place in the ballot will introduce it. From the same source we learn that resolutions in favour of the Bill have now been passed by 408 city corporations and town and district councils, including the Cities of London, Westminster, Glasgow, Liverpool, Belfast, Dublin, Sheffield, and Bradford, and a majority of the London boroughs—that is to say, seventeen out of twenty-eight. It is scarcely to be

expected that the representatives upon these bodies should be familiar with the zone system of standard time reckoning now recognised throughout almost the whole civilised world, for if they were they would understand the practical and international importance of the invariability of the Greenwich meridian upon which the system is based. Surely in a matter of this kind expert knowledge is a safer guide to follow than argument derived from the counting of heads. What is wanted is the opinion of astronomers, navigators, and others, who know the meaning of standards of time and longitude, rather than of city corporations and district councils, which would just as cheerfully pass a resolution in favour of a periodical change of position of the equator as they do that for placing Greenwich in the longitude of Berlin during certain months of the year.

Mr. C. G. Abbot, director of the Smithsonian Astrophysical Observatory, has just returned to Washington from Bassour, Algeria, where he has been making astrophysical observations in regard to the solar constant of radiation. The observing station in Bassour was established in July, 1911, when Mr. Abbot and his field assistant, Prof. F. P. Brackett, of Pomona College, arrived in Algeria, and observations were continued until the end of November. From previous work at Washington, Mount Wilson, and Mount Whitney, it had been determined that the sun was probably a variable star, and that apparently its radiations frequently fluctuated from 2 to 5 per cent. during irregular periods of from five to ten days' duration. Although strongly indicated by the work on Mount Wilson, the result was so important that it seemed necessary to test it further by means of simultaneous independent observations held at Mount Wilson and some other high altitude station remote from there, where an equally cloudless atmosphere existed. Mr. Abbot made complete determinations of the solar constant of radiation for forty-four days in Bassour, while his assistant, Mr. L. B. Aldrich, made similar measurements at Mount Wilson, Cal. The two observing stations were separated by a distance nearly equal to that of one-third the circumference of the earth, thus making the locations ideal in that respect. Unfortunately, some cloudy weather was encountered at each of the stations, but the records of about thirty days will be available for comparison.

The *Evening News* of February 1 made some interesting remarks on Candlemas, February 2, one of the great festivals of the May or agricultural year which precedes the present solstitial year. The church candle festival followed the lighting of bonfires or blazes in the stone circles, and was dedicated to St. Blazius. The proverbs show that the day has always been considered a critical one from the meteorological point of view—indeed, "The proverbs which cluster round this day are more numerous than those about St. Swithin's, St. Martin's, and St. Michael's Days combined. And they all refer to the weather."

"If Candlemas Day is come and gone,
The snow lies on a hot stone (*i.e.* soon melts)."

"If Candlemas Day be fine and clear,
There'll be two winters in the year."

"A windy Christmas, a calm Candlemas,
Are sure signs of a good crop of grass."

"If Candlemas Day bring clouds and rain,
Winter is gone and won't come again."

"If the lark sings before Candlemas (it did in 1912)
She'll soon cry out and mourn alas!"

These proverbs are followed by a letter from a correspondent, who writes as follows:—"You may sum up this British proverbial wisdom thus: If February 2 (Candlemas Day) is cold, we shall have a cold, late spring and a fine summer. If wet and warm, the chances are we shall get a dismal summer after a fine, open spring. Some of the scores of available proverbs contradict each other on minor points. They all agree that February 2 (Candlemas Day) is a critical point in the year. It sets the barometer and thermometer for us. For years I have verified it, and my advice is, watch the weather on February 2."

The December (1911) number of *The Journal of Hygiene* (vol. xi., No. 4) contains a paper by Drs. Stokvis and Swellengrebel on the purification of water by an infusorian (*Colpoda cucullus*). Numbers of Colpodæ were added to emulsions of bacteria in water, and as a result the water was clarified, and the bacteria were removed. The purification was effected only in the presence of living Colpodæ.

We have received the first number of *The Journal of Vaccine Therapy*, which is edited by Dr. R. W. Allen and published by Mr. H. K. Lewis. It contains papers on the vaccine treatment of rheumatic fever and chorea by Dr. Buchanan, of typhoid fever by Dr. Sadler, and of acne by Dr. Allen. Important as vaccine treatment is, we scarcely think that the subject requires a special journal.

The Malaya Medical Journal for last October (vol. ix., part iv.) is devoted to the subject of beri-beri. Recent research, in particular by Braddon, Fraser, and Stanton, strongly suggests that the use of "polished" rice, which seems to be deficient in certain nutritive qualities, is the cause of this disease. The editor, however, points out that there are certain outbreaks which do not seem to be explicable on this hypothesis, and publishes a translation of a paper by Kohlbrugge in which it is suggested that certain acid-forming bacteria present on rice may be the actual cause of beri-beri.

At the present time, when public interest is directed to the political situation of China, we may direct attention to two valuable papers contributed by Mr. E. W. Capen to the fifth volume of the Publications of the American Sociological Society. In the first this writer, who is familiar with the conditions of inner China, gives a graphic account of his observations. He describes, in order, the struggle for existence, the physical constitution of the people, their mental characteristics, the organisation of family life, the evils resulting from neglect of forest conservation, and the lack of patriotism among the rural population. It is, on the whole, a melancholy picture of social decay as the result of misgovernment. The most interesting portion is that in which he discusses the physical characters of the people and their power of resistance to disease and injuries as compared with Europeans. In the second paper he reviews with ample knowledge the effects of Western influences upon the people of the Orient.

After an exhaustive study of the limb-arteries of the Primates, the details of which are recorded in the January number of *The Journal of Anatomy and Physiology*, Mr. T. Manners-Smith arrives at the conclusion that these arteries—as, indeed, had been previously suggested—are arranged on a definite system. They are, in fact, formed on a segmental plan, and to some extent appear to have constituted portions of the tubules of an arterial plexus with longitudinally arranged meshes. "We must also regard the normal arrangement, which is proper to a par-

ticular family or species, as the result of mechanical conditions affecting the particular family or species in such a way that the departure from the general reticular plan is fixed and definite for the animal in question."

The American Bison Society, in its fourth annual report, 1910–11, has to deplore the loss of the services of its president, Dr. W. T. Hornaday, who has been compelled by pressure of other work to resign that position. He has been elected the first honorary member of the society, and is succeeded in the presidential chair by Prof. F. W. Hooper. Despite a few mishaps, matters appear to be going well with the survivors of the bison in its native country, the total number of pure-bred animals being 2760, against 2108 in 1910 and 1917 in 1908. Attempts to capture the remnant of the Pablo herd in the Flathead country for the Canadian Government have had to be abandoned on account of the wild state of the animals, which have become completely uncontrollable. The society is anxious to establish a new herd in one of the Dakotas, preferably South Dakota, which formed part of the headquarters of the bison, and the proposal has been favourably received by the secretary to the Federal Government. Efforts are also being made with a view to the establishment of a herd either in the Adirondack Range or in the new Hudson River Park, New York State.

The horned lizards, or "horned toads," of California and Nevada form the subject of an illustrated monograph by Mr. H. C. Bryant in the Zoological Publications of the University of California (vol. ix., No. 1), which also includes a survey of the whole group. In the second edition of the British Museum "Catalogue of Lizards," twelve species, all included in the genus Phrynosoma, of these strange reptiles were recognised; but Mr. Bryant now admits sixteen, one of which, from the desert tracts of the Gila and Colorado valleys, is made the type of a separate genus, under the name *Anota maccalli*, its claim to this distinction being based on the length, smoothness, and conical forms of the horns, the presence of three (in place of one or two) rows of peripheral spines, the flattened tail, and the existence of supratemporal openings in the skull. Excellent figures show the specific variation of the skull, which in its horn-sheathed spines exhibits a remarkable parallelism to some of the dinosaurs. These horns are considered to be for defensive purposes, serving to frighten certain enemies, although it is scarcely conceivable that they can be efficacious in the case of rattlesnakes, which are some of the worst foes. Some of these lizards are viviparous, but others are oviparous, the eggs being in the case of one species buried in the sand, although in a second they are hatched almost immediately after extrusion. Particulars are given with regard to the remarkable habit possessed by these lizards of spurting jets of blood from the eye, from which it appears that the phenomenon is preceded by congestion of the upper eyelid, from the under-surface of which the jet issues.

Little information has hitherto been accumulated about the composition of cow's milk in India. Messrs. Meggitt and Mann have recently published in the Memoirs of the Department of Agriculture in India a number of analyses which show that the milk contains a high percentage of butter-fat, as much as 5 or 6 per cent., against a general 3 per cent. in England, but there is very great variation even among animals of the same breed. Indeed, the whole investigation emphasises the extremely unselected character of the herds, and suggests possibilities of marked improvement if selection is carried on over a sufficient time.

In the October (1911) number of *The South African Journal of Science*, the organ of the South African Association for the Advancement of Science, Dr. Juritz describes the results of the chemical investigations he has made in Cape Colony during the last twenty years or more. They deal with waters, poisonous plants, soils, fertilisers, cereals and other agricultural produce, and minerals, and afford an admirable illustration of the way in which the chemist can serve a new country. A short biography is given of the late Dr. Bolus, who played so prominent a part in the development of botany in Cape Colony.

Of the many problems connected with soil fertility, few are more important than those centring round soil erosion. The causes and remedies are dealt with at some length by Mr. M'Gee in Bulletin 71 of the United States Department of Agriculture, Bureau of Soils, where some admirable photographs also are given showing the various types of erosion. Whenever land is brought into cultivation and then neglected, erosion is likely to be serious; only when the surface is covered with vegetation can it resist the disintegrating effect of the rain. Very slight depressions in the surface suffice to form a channel, which rapidly widens and deepens, and before long attains considerable dimensions. The remedies consist, therefore, in planting the land and in terracing.

A useful article dealing with two prevalent diseases of the potato plant is contributed by Mr. R. S. Horne to the Journal of the Royal Horticultural Society (vol. xxxvii., part ii.). The author sifts carefully the conflicting statements ranged round the lowly fungal organism *Chrysophlyctis endobiotica*, producing a disease known under the different names "tumour," "warty disease," and "black scab," and contrasts the swellings induced by it with the more pronounced canker caused by the myxomycete *Spongospora solani*; the latter disease is known as "corky scab," or "potato canker." The author adopts the terms tumour and canker because they indicate the actual nature of the diseases, which are, of course, quite distinct from the potato disease due to *Phytophthora infestans*. Attention is also directed to a note by Mr. F. J. Chittenden in the Journal discussing self-sterility of apple trees, that is, the dependence of fruit formation upon pollination of the flowers with pollen from another variety.

In the January number of *Petermann's Mitteilungen* Prof. A. Woeikow discusses the salinity of the oceans, and in particular the greater salinity of the Atlantic Ocean as compared with either of the others, and this in spite of the continental area which drains into the Atlantic being far larger than those which feed the Pacific and Indian Oceans. He attributes the higher salinity of the Atlantic to the large amount of water-vapour which is carried on to the continents, which are of comparatively low altitude where they front this ocean. A map of the salinity of the oceans, the drainage areas supplying them, and the altitudes of coast margins is included.

In *The Geographical Journal* for January, Sir David Gill, F.R.S., describes the 4-metre and 24-metre comparators which have been constructed for the Government of India by the Cambridge Instrument Company under his supervision. The former is for comparing all standards of length up to 4 metres, and enables the determination of their absolute coefficients of expansion by heat; the latter is designed for comparing the lengths of 24-metre invar wires or tapes with a standard 4-metre bar. Unfortunately, only a summary is given of the description of these important pieces of apparatus, and no plans are included.

At the same meeting Mr. J. A. A. Baugh discussed the preparation of invar tapes, and quoted the results of experiments made to determine their variation due to ageing, rolling and unrolling, and tension. The experiments were very instructive, though the number quoted was small. He referred to the difficulty of determining the true temperature of a tape suspended in air, and advocated its determination by means of its electrical resistance. Mr. B. F. E. Keeling directed attention to this difficulty in 1910, and showed that there might be as much as 2° C. between the tape and the surrounding air.

REFERRING to the letter on concentric joints in ice by Mr. H. J. F. Gourley in NATURE of January 25, Julia R. Grugell, of Burleigh Stroud, Gloucestershire, sends some observations on the same phenomenon. The roadside pool studied was 6 feet long, 4 feet broad, and 1 foot deep in the middle and about 3 inches at the side. The rings seen only followed the line of the edge on one side, and halfway round the ends, projecting stones apparently interfering with their formation on the other side. A piece of ice, 16 inches square, cut out and examined showed the bulb formation. The ice was 2 inches thick at the edge, and the first bulb was 3½ inches from the edge and projected 2 inches, being followed by four others of varying shapes. Along the line of the rings the bulbs appeared to be continuous, except the second, which was saucer-shaped in appearance. Looking at the surface of the pool, which was of very smooth ice, the rings were seen alternately clear and opaque, and inspection of the undersurface of the piece removed showed the bulbs were clear through to the surface. The opaque effect seemed to be due to ice crystals on the under-surface of the ice. The ice was the result of several nights' frost, with no thaw by day.

IN connection with the exceptionally warm weather of last summer in Europe and the United States, an article by Mr. R. C. Mossman in *Symons's Meteorological Magazine* for January, on the "Abnormal Weather in South America during 1911," is of considerable interest. For the region north of lat. 40° S. in Argentina and part of Brazil the following mean temperatures below the normal (1898–1907) are given for the four months June-September:—mean max. 2·5° F., mean min. 3·0°, mean temperature 2·7°. From a map showing the departures of the mean temperature for the three months June-August in Argentina it is seen that the greatest depression, viz. 5°, was in a small area in the province of Corrientes. South of latitude 35°, except for a small patch in Buenos Aires, the depression did not exceed 2°, and south of 41° the temperature was above the average, reaching an excess of 3·5° near the Atlantic entrance to the Straits of Magellan. The author observes that there is little doubt that during the year in question a marked displacement of the "centres of action" of both hemispheres took place. In South America the meteorology of the whole year presented a sequence of abnormal features, among the most prominent being excessive rainfall at Rio de Janeiro in March, 1911, and extreme drought in Buenos Aires in the same month.

A COURSE of lectures delivered before the students of the Johns Hopkins University by Dr. Charles Edward Brooks, on "Tables of Mortality and the Theory of Probability," is published in abstract in the Johns Hopkins University Circular, No. 10. The abstract of the six lectures only occupies forty-two pages, and is accompanied by a reprint of the "American Experience" table of mortality. It should enable any student possessing an elementary knowledge of algebra and the mere notation of the calculus to solve ordinary problems on life insurance with a very small amount of preliminary study. It shows that the study of probabilities and statistics is not nearly so difficult as is commonly supposed. It is highly desirable that schoolboys should learn the elementary notions of probability soon after they have learnt to multiply vulgar fractions, and that the elements of statistical mathematics should be taught in schools and colleges in place of much of the present useless algebraical drill.

A REPORT on graduate work in mathematics in the United States universities and colleges is published in the Bulletin of the American Mathematical Society for December, 1911, and forms part of the report of the International Commission on the Teaching of Mathematics. It would appear that forty years ago practically no facilities existed for the study of higher mathematics, the school established at Harvard under Benjamin Peirce being one of a few noteworthy exceptions. At present a much more satisfactory state of affairs has been reached, many institutions, both large and small, possessing well-attended schools of higher study frequented by both graduate and undergraduate students. The report deals, further, on the advantages and disadvantages of study abroad, the former including the acquisition of foreign languages. In regard to the training of teachers in higher mathematics, the report reveals a very different state of affairs from that now prevailing in England, namely, an excess of demand over supply. This, in the opinion of the committee, is likely to have a disastrous effect in encouraging graduates of mediocre ability to undertake some work that they can call "research" in order to qualify as college instructors.

WITH the aid of the Rumford Fund, Mr. P. W. Bridgman, of the Jefferson Physical Laboratory of Harvard University, has continued his experiments on the properties of substances under pressures up to 12,000 atmospheres. His most recent work relates to mercury, and the results are published as Memoir 12 of vol. xlvii. of the Proceedings of the American Academy. He uses a steel piezometer, through the bottom of which a minute hole is made. The piezometer is filled with mercury, and is subjected to pressure in a cylinder of water. As the pressure is applied, water is forced into the piezometer. When the pressure is withdrawn mercury flows out, and the amount which remains in the instrument allows the compression to be determined if those of the water and the steel are known. That of steel was determined independently by the change of length of a rod under pressure. That of water was measured by inverting the piezometer, filling it with water, and subjecting it to pressure in a cylinder of mercury. As the experiments were carried out at temperatures from −39° C. to +22° C., they allow the isothermals for solid and liquid mercury between these limits to be drawn on a pressure-volume diagram.

VOL. vi. of the Journal of the Institute of Metals contains the May lecture of 1911, delivered by Dr. G. T. Beilby. The title, "The Hard and Soft States in Metals," gives a very inadequate idea of the importance of the conclusions which the author has reached by his investigations on metals and other substances. The central fact appears to be that the molecules of any pure substance may be assembled in two different ways, each of which imparts to the substance distinct physical properties. In the first form the substance is crystalline, stable under heat treatment, but yields readily to mechanical forces. In the second the substance is amorphous, becomes crystal-

line under heat treatment, but is much more stable under mechanical forces than the former. Even gentle polishing of a surface is sufficient to break down the first or crystalline form near the surface, and the material flows, ultimately solidifying in the second or amorphous state. Wire-drawing or other mechanical treatment produces the same effect, and the author shows how most of the properties of materials used in construction are due to the presence in them of molecules in the two states of aggregation.

A PAPER by Dr. E. Weiss, of the University of Prague, which appears in the July (1911) number of the *Sitzungsberichte* of the Academy of Vienna, offers a satisfactory explanation of the deviations of the values for the elementary quantity or "atom" of electricity found recently by Dr. Ehrenhaft and by Dr. Przibram from the value found by Prof. Millikan. Like the other observers who have worked in this field, Dr. Weiss uses the speed of motion of electrically charged minute particles of matter either under gravity alone or under gravity and an electric field combined. His particles were of silver of diameters about 10^{-5} cm., obtained by the aid of an electric arc. His arrangement allowed the same particle to be observed during twenty or more falls, and the speeds found differed amongst themselves by 50 per cent. in the case of the smallest particles. When Stokes's law, either in its original form or with Cunningham's correction, is applied to the observations, the values of the electric charges in many cases come less than the atomic charge. Weiss shows that this is due to the particles executing Brownian movements, and when he applies Einstein's theory of these motions to the observations, he finds they give values of the atomic charge between 4 and 5×10^{-10} electrostatic units, in agreement with the number generally accepted.

THE isolation by Willstätter and Esch, recorded in the current number (vol. lxxvi., Heft 2 and 3) of the *Zeitschrift für physiologische Chemie*, of the yellow pigment of yolk of egg in a crystalline state, and the identification of its chemical nature as closely related to the xanthophyll of green leaves, is an important contribution to knowledge. Willstätter's earlier work enabled him to classify the chemically indifferent colouring matters of animal and plant pigments into two classes, the hydrocarbons, $C_{40}H_{56}$, of the carrotene group, soluble in light petroleum, and the related oxygen compounds, $C_{40}H_{56}O_2$, of the xanthophyll series, soluble in alcohol. Nearly two years ago he was able to show that lycopene, the red pigment of tomatoes, was a member of the carrotene group. As the result of the extraction of the yolks of 6000 hens' eggs, about 4 grams of a crude pigment remained. This has been purified by crystallisation from a variety of solvents, from which the pigment, which it is proposed to name luteine, separates in characteristic coloured forms. Analysis shows it to be an isomeride of xanthophyll, and this is confirmed by the study of the absorption spectrum and other properties.

AT a meeting of the Institute of Chemistry, held at University College, London, on January 26, a lecture was delivered by Mr. C. F. Cross on "Cellulose." He pointed out that cellulose, as a basis of manufacture, takes an important position. Primary manufactured products at factory cost represent values approaching 200,000,000*l.* per annum for the United Kingdom. Cellulose derivatives form the basis of smokeless powders, an indispensable auxiliary to photographic art, and the raw material of "celluloid." Taking cellulose as a typical colloid, and enlarging our view to include industries based upon colloids, their preponderance is evident. Industry is chiefly busy in transforming colloidal substances of entirely natural origin. Normal cellulose is still rather a laboratory term and product. The so-called "pure" cellulose in the form of chemical filter papers represented about 90 to 95 per cent. only of "normal" purity. The supposed identity of "rag cellulose" with "normal cellulose" is an illusion. Mr. Cross suggested that the type of combination of lignone with cellulose to form the complex "lignocellulose" may in time modify our views of chemical combination.

WE learn from *The Engineer* for February 2 that in the middle of last month there was put to work a single-deck petrol tramcar on the short tram-line connecting Morecambe and Heysham. This car is the first of three ordered for this service, is capable of carrying thirty-seven passengers, and is driven by a 55 horse-power four-cylinder petrol motor. Now that the petrol tramcar is an accomplished fact, it will be interesting to watch the effect on the fortunes of electric tramway systems. There appears to be no reason why petrol tramcars should not answer their purpose as well as electric cars, and it is evident that success will render them formidable opponents. It is too early as yet to attempt any comparative estimate of costs of running or of upkeep, but it must be remembered that the electric system calls for heavy expenditure in overhead or underground equipment, and also for a generating station in those cases where the tramway authority cannot purchase its electricity.

BULLETIN No. 49 of the University of Illinois contains an account of tests on nickel-steel riveted joints carried out by Messrs. A. N. Talbot and H. F. Moore at the university engineering experiment station. A total of ninety nickel-steel and fifty-four chrome-nickel-steel joints were tested in tension, sixteen nickel-steel and sixteen chrome-nickel-steel joints were tested in tension, compression, and alternate tension and compression. Stretch, slip, and set of riveted joints were observed, as well as the bending of the rivets. There was a noticeable slip of joint generally at loads within ordinary working shearing stress of rivet. The movement of the joint increased fairly regularly to a load averaging about 35,000 lb. per square inch of rivet shear for the nickel-steel joints, when a marked increase of movement was found. This increase was closely coincident with a marked set of the joint and with a marked bending of the rivet. All the riveted joints failed by shear of the rivets, at ultimate shearing stresses, which ran fairly uniform in both the nickel-steel and the chrome-nickel-steel series for all the types of joint tested. In the alternated load tests, the most striking feature was the relatively large slip which took place at comparatively low loads. The amount of this slip was especially large when a joint had been subjected to a single load considerably beyond the ordinary load.

PROF. A. M. WORTHINGTON, C.B., F.R.S., contributes to the February number of *Pearson's Magazine* a well-illustrated article upon his photographic analysis of the splash and jet produced by dropping a rough marble into water from different heights. The same number contains an account of the life-story, with illustrations, of the nightjar, by Mr. E. C. Andrews.

THE annual volume for 1911 of the "Bulletin of Miscellaneous Information" of the Royal Botanic Gardens, Kew, is now available. The volume is published by H.M. Stationery Office at the price of 4*s*. 6*d*., and may be purchased from Messrs. Wyman and Sons, Ltd., of Fetter Lane, London, E.C. Several of the papers in the ten separate numbers included in the volume have already been noticed from time to time in these columns.

OUR ASTRONOMICAL COLUMN.

DOUBLING OF MARTIAN "CANALS."—Telegraphing to the *Astronomische Nachrichten* (No. 4551) on January 25, Prof. Lowell states that the canals Ganges and Jamuna are doubling, both from the western mouth.

REPORTED FALL OF AN AËROLITE.—A curious accident is reported in a Lloyd's message from the Finisterre (Spain) Signal Station. The message states that at 9 a.m. on January 25 the semaphore and telegraphic apparatus was completely destroyed by the fall of a meteor, thus causing an interruption of both the maritime and land communications. Nothing, more than is implied in the above message, is reported as to the finding of any meteorite or its fragments.

A BRIGHT METEOR.—From Tarnów Prof. Anton Wilk reports the apparition, in a clear, cloudless sky, of a bright meteor on November 15, 1911. The path lay between 20h. 20m., $+40°$, and 22h. 40m., $+30°$, and was traversed very rapidly. At the beginning of the flight the meteor was about twice as bright as Venus, whilst during the flight it gave off luminous particles, and was followed by a long luminous trail. At first the colour was bluish, then a glowing yellowish-white, and the duration of the whole phenomenon was about three seconds.

EPHEMERIS FOR SCHAUMASSE'S COMET, 1911*h*.—*Astronomische Nachrichten* No. 4549 contains an ephemeris for comet 1911*h*, computed by M. Schaumasse from the elliptic elements now published by M. Fayet in the same journal.

The present approximate position is 16h. 19m., $-3° 57'$, and the comet is only about one-sixth as bright as when discovered.

M. Fayet directs attention to the similarity of the orbits of this comet and that of 1894 I. (Denning).

OBSERVATIONS OF COMETS.—Bulletin No. 3 of the Khedivial Observatory, Helwan, contains a further list of positions of Halley's comet determined from photographs taken with the Reynold's reflector by Mr. Knox-Shaw. It has been found desirable to apply a temperature term in the reduction of the measures, the temperature having varied between 6° and 24° C.

Numerous observations of comets are recorded in Nos. 4550–1 of the *Astronomische Nachrichten* from several observatories.

DISTANCES OF SPIRAL NEBULÆ.—Assuming that the spiral nebulæ are external galactic systems, Prof. Max Wolf makes some speculations as to their relative distances in No. 4549 of the *Astronomische Nachrichten*. His deductions are based also on the assumption that such systems are of the same order of actual magnitude, hence the apparent diameters are inverse measures of their distances.

Measures of eight objects have been made, and the relative distances derived, both from the measures of the length and the breadth; the results for each object agree fairly well. Taking the parallax of certain objects in the Milky Way, *e.g.* Nova Persei, as 0·01″, gives a means of calibrating the relative scale, and Prof. Wolf's final speculative numbers are as follow:—

Object	Distance in light years	Apparent diameter, ′	Diameter in light years
M31	33,000	120	1100
M33	94,000	54	1500
M81	172,000	18	900
M101	289,000	18	1500
M51	370,000	10	1100
$H_5 24$	500,000	15	2200
$H_4 76$	522,000	7	1100
$H_1 56$	578,000	8	1300

OBSERVATIONS AT THE MOSCOW OBSERVATORY.—The fifth volume of the *Annales de l'Observatoire astronomique de Moscou* is a handsome volume, in which Prof. Ceraski publishes numerous results derived from various observations made since the new observatory was installed in 1900; the frontispiece is a reproduction of a photograph of the new buildings.

Among other results, Prof. Ceraski gives those obtained for the stellar magnitude of the sun in two separate researches in 1903 and 1905. In the first he compared the sun with Venus, and then, in the evening, Venus was compared with α Leonis. The sun was found to be 242,400,000,000 times brighter than the star, and, taking Müller's magnitude (1·57) for α Leonis, the sun's magnitude is $-26·89$. In the later research other stars were also employed, and $-26·5$ was obtained as a more trustworthy value of the sun's magnitude.

Other papers deal with the angular velocities of Perseid meteors, a special eyepiece for solar observations, a method of utilising the sun's heat, the intensity of the luminosity of the atmosphere near the sun's limb, &c. Further, M. Sternberg has a long paper on the application of photography to the measures of double stars, and M. Blažko writes concerning Algol variables, and describes a type of slitless spectroscope. In the appendix a large number of photographs showing the regions around variable stars, discovered by Madame Ceraski, are reproduced.

INTERNAL AND CLOUD VELOCITIES OF GROUPS OF STARS IN RELATION TO SPECTRAL TYPE.—In No. 5, vol. xxxiv., of *The Astrophysical Journal*, Dr. Weersma arrives at some interesting results arising from a mathematical inquiry into the ratio between the linear velocities of the individual members of star groups and the general velocities of the groups as a whole, as it exists in different spectral types. Prof. Kapteyn, in a paper published in 1910, found that the individual linear velocities of stars increase with age, and suggested that this phenomenon probably entails a dissipation of star groups as they grow older. Dr. Weersma now shows, from a study of A-type and K and M-type stars, that this suggestion is probably correct. He finds that the individual velocities do tend to increase with age, while there is apparently a tendency for the group velocities to diminish; the evidence for the latter, however, is by no means conclusive.

SILK-CULTURE IN THE PHILIPPINES.[1]

SILK production is one of the most important industries in most of the warmer parts of the world; but the mulberry silkworm, *Bombyx mori*, still supplies by far the largest proportion of this commodity.

As regards the Philippines, although the Jesuit Father Antonio Sedwo made large plantations of mulberry in 1593, and introduced silkworms, and in 1780 the Augustinian missionary Father Manuel Galiana sent both mulberries and silkworm eggs from China, and the silk industry was carried on for a while with success, yet it seems subsequently to have been neglected until about six years ago, when the Bureau of Science again introduced mulberry silkworms into the Philippines, under the auspices of the American Government, which, at the same time, promulgated an Act forbidding the introduction of silkworms into the Philippines by unauthorised persons.

This was due to the fear of the probable importation of silkworm diseases; but it may also be pointed out that the introduction of that terrible pest the gipsy moth into America was due to an entomologist carrying on experiments with possible silk-producing moths; and great care should always be taken in introducing an animal or plant into a new country, as it sometimes becomes an unexpected pest, even though it may be innocuous in its native home.

The Bureau of Science began by importing the eggs of silkworms from Japan in 1905, but it was found impossible to preserve the eggs of the next brood. Therefore, in 1907, cocoons of four different varieties were obtained from Ceylon, and these proved to be a great success. The pamphlet before us gives a full history of the development and management of the insects in all their stages.

Having succeeded so far, the Bureau of Science attempted in 1909 to introduce the Eri, or castor-oil silkworm, *Attacus ricini*, belonging to another family of silk-producing moths, also from Ceylon. The treatment of the silk produced by this insect is different from that used for the mulberry silkworm, for the moth must not be allowed to emerge from the cocoon, and the cocoons cannot be reeled, but must be spun like wool or cotton, though when thus treated they yield a very fine silk.

[1] "A Manual of Philippine Silk Culture." By Charles S. Banks. (From the Entomological Section, Biological Laboratory, Bureau of Science, Manila). Pp. 53+xx plates. (Manila: Bureau of Printing, 1911.)

This moth is closely allied to, if not a form of, *Attacus cynthia*, the Ailanthus silkworm, which Dr. Alexander Wallace attempted to introduce into England some years ago. It is a very handsome species in all its stages, as

FIG. 1.—Adult male and female of *Attacus ricini*, Boisd., the Eri moth.

may be seen by the accompanying figures of the moths and caterpillars.

The castor-oil plant grows wild in the Philippines, and this silkworm is more easy to rear, and requires less care

FIG. 2.—Eri silkworms ready to spin: half natural size.

than the mulberry silkworm. Several other silkworms are found in the Philippines, some of which may possibly be ultimately utilised as silk-producers.

Enemies and diseases of silkworms are discussed. The most important of the former are ants, rats, and mice; and hitherto it has been possible to keep silkworms in the Philippines almost entirely free from disease, by constant care and supervision.

Other matters treated of in this useful pamphlet are the silk house, the mulberry, shipping eggs, the silk trade of the Philippines, &c. The plates illustrate the mulberry and Eri silkworms in all their stages, cocoons of *Antheraea semperi*, one of the wild silkworms, a mulberry nursery and plantation, plans of a silk house, and various machines used for silk-weaving, &c.

This pamphlet is a good illustration of what may be accomplished by a little energy and foresight in the way of introducing a profitable industry into a comparatively new locality.

W. F. K.

THE RECENT FROST.

THE closing days of January and the early days in February witnessed a keen frost over the British Isles, but from the current weather changes it seems probable that the frost has come to an abrupt termination. At Greenwich the temperature fell below the freezing point each night for ten consecutive days, from January 27 to February 5. The lowest shade temperature was 19°, recorded on January 29 and February 3, whilst the lowest maximum day temperature was 27°, on February 4, which day also had the lowest mean of maximum and minimum temperatures—24°. The mean maximum or day temperature at Greenwich for the ten days was 35°, which is 10° below the average of the last fifty years, and the mean of the lowest night temperatures 24°, which is 11° below the average; the mean of the maxima and minima for the whole period was 30°. At the meteorological station at Hampstead the shade temperature on February 3 was 16°, and on the surface of the grass the thermometer registered 6°. In the frost of 1894–5 the average temperature at Greenwich for the whole of February, 1895, was 29°, and in the frost of 1890–1 the mean for December, 1890, was also 29°. Both these frosts were, however, much more prolonged than the spell just experienced. The recent frost was more keen over the country generally than any experienced since the winter of 1894–5, when special trains were run for London skaters to Loch Lomond, which *The Times* of February 6 reports now to be covered for about a mile with good sheet-ice—the first occasion for the last seventeen years. A region of high barometer was centred over the British Isles during the early period of the frost to the close of January, but during the latter period of the frost the barometer was low over England, and the atmospheric conditions were complex in character.

A summary of the weather issued by the Meteorological Office for the week ending February 3, which embraces the severest weather of the recent cold spell, shows that the temperature was much below the average over the entire kingdom, the deficiency amounting to 10° in the south-west of England and the Midland counties, and to about 9° in several other parts of Britain. The lowest temperatures are said to have occurred on February 3 over the kingdom generally. Some of the lowest shade temperatures reported are 4° at Balmoral on February 2, 4° at Nairn on February 5, 9° at Llangammarch Wells, in the south-west of England, on February 3. The lowest readings on the surface of the grass were −0·3° at Norwich at 11 p.m. on February 2, and 0° (zero) at Balmoral and Burnley.

SKULLS AND PHYSIOGNOMY.

AT the present time anatomists are divided as regards the possibility of reconstructing from the skull the appearance of the face and head during life. Those interested in this problem will find a recent pamphlet by Prof. von Eggeling, of Jena ("Physiognomie und Schaedel," Fischer, Jena, 1911, price 1.20 marks), of the greatest assistance, for the author has summarised in a very clear manner the various results obtained by previous investigators, and added his own observations. Such researches were at first employed to ascertain whether the skulls, which were alleged to be those of famous men, really corresponded with their death-masks. In 1867 Prof.

Welcker compared the measurements of a skull said to be that of Dante with the poet's death-mask, and found that the agreement was exact enough to warrant the authenticity of the skull. In 1893 Virchow, after comparing a skull which was found by archaeologists in circumstances which led them to believe it to be that of Sophocles with busts of the poet, was unable to give a decided opinion.

The first complete investigation of this kind was made by Welcker in connection with Schiller's skull; the discrepancies between the death-mask, which he accepted as authentic, and the skull were so great—more than he found between modern skulls and faces—that he came to the conclusion that the skull could not be that of Schiller. In 1898 Kollmann and Büchly attempted to reconstruct the physiognomy of a young woman from a skull found in the débris of a lake-dwelling. The bust was criticised by Merkel, who came to the conclusion that the skull gave no clue to the essential parts of the face—the eyes, nose, and mouth. He was led to alter his opinion, however, by handing a skull to a sculptor and asking him to reconstruct the face. The skull was that of an Australian native. The sculptor returned and told him it was impossible to mould a European face on such a skull; the one he ultimately modelled had the features of the race to which the skull belonged.

Prof. von Eggeling has performed a real service to anthropologists and given them the hope of ultimately securing a scientific basis for obtaining trustworthy reconstructions of the face from a study of its skeleton.

In a paper which has appeared in the *Berichte der Naturforschenden Gesellschaft zu Freiburg-im-Br.* (October, 1911) Dr. J. Kalkhof gives the results of a series of measurements of the orbits made on more than 800 human skulls belonging to various races. He found that although the right and left orbits are approximately equal in height, the left, in two-thirds of the skulls examined, was distinctly wider than the right. Some ten years ago Miss Fawcett and Dr. Alice Lee, while examining the crania of prehistoric Egyptians from Naquada (*Biometrika*, vol. i., p. 408), found that the left orbit was not only wider, but also higher, than the right. It may therefore be accepted as proved that in the majority of individuals the left orbit is more capacious than the right. The explanation of the predominance of the left orbit is not easily explained, but it will probably be found that it is due to the greater use of the muscles of mastication of the right side. Dr. Kalkhof has introduced a method of estimating what he has termed the diagonal axis of the orbit, but its utility is not very apparent. He notes the remarkable shape of the orbits of the prehistoric Cro-Magnon race, especially the horizontal direction of the upper orbital margins. We observe that Prof. Elliot Smith, in his recently published book on the ancient Egyptians, uses the shape of the orbits as a criterion for distinguishing an alien people from the real Egyptians.

THE SECOND MENDELÉEFF CONGRESS OF PURE AND APPLIED CHEMISTRY AND PHYSICS.

THE second Mendeléeff congress of Russian chemists and physicists was held at the University of St. Petersburg on January 3–10. The number of members was unexpectedly large, namely, 1700 (that at the first congress was 1008); there were about sixty general, joint, and sectional meetings, at which more than 220 communications were made. Short abstracts of these papers, together with the discussions, were published in the daily "Diary" of the congress.

On January 3, after a funeral service in the University church in memory of Mendeléeff and the honorary president, Beketoff, there was inaugurated the "Mendeléeff Museum"—a suite of three rooms of the University lodging, which Mendeléeff occupied as professor, containing his library and furniture, all fitted up exactly as it was twenty-five years ago. At two o'clock the inaugural meeting was held in the adjoining Great University Hall, where, after election of the president, vice-presidents, and secretaries of the congress, Prof. Osipoff (Kharkoff) spoke on the scientific work of Beketoff, and Umoff (Moscow) on the characteristics and actual problems of the natural sciences.

The evening of that day, and the three following days, were devoted to sectional meetings. On Christmas Day (January 7) there was only one meeting (physical section), and several hundred members made an excursion by special train to the Falls of Imatra (Finland). On the next day, January 8, the congress was invited to the Polytechnic Institute (village Sosnovka, near St. Petersburg), where meetings of the sections of aërodynamics, radio-telegraphy and applied physics, metallurgy and electrochemistry took place, followed by an inspection of all the buildings and laboratories of this vast institute. In the evening a general joint meeting with the Russian Physico-chemical Society was held at the University, the communications made being:—Walden (Riga), electrolytical dissociation in non-aqueous solutions; and Lazareff (Moscow), application of thermodynamics in chemistry. The day was closed by a banquet, attended by some 500 members.

January 9 was devoted to sectional work, and January 10 witnessed the closing meeting of the congress. After addresses by Prof. Walden (Riga) on the development of chemistry in Russia, and Prof. Goldhammer (Kazan) on modern conceptions of time, space, and æther, the reports of the secretaries were read, and several resolutions of sections adopted. Then a vote of thanks to all who contributed to the success of the congress was passed, and the president declared the congress closed. The third Mendeléeff Congress will be held in 1914.

Turning now to the work done in the different sections, we notice that some of the sections proposed did not meet, as no papers were presented; others were very crowded, and held meetings as often as possible. The great number of communications does not allow more than a mention of the titles of those presenting a general interest.

(1) Section of Chemistry.—In the eight sectional meetings about eighty communications were made; of these, the following may be mentioned:—Borodovski (Yurieff), determination of atomic weight of elements by means of absorption of electrons; Speranski (Kieff), adsorption of dissolved substances by ice; Kuznezoff (Kharkoff), catalytic decomposition of aldehydes; Grinakovski (Tomsk), linear velocity of crystallisation in capillary tubes; Bubanovich (Zagreb), criticism of Traube's theory of superficial tension; Fisher (Riga), mechanism of crystallisation in aqueous and alcoholic solutions; Dumanski (Kieff), nature of colloidal solutions; Wurzel (St. Petersburg), latest determination of atomic weight of nitrogen (14,007).

The Chemical Section held three joint meetings with the Section of Physics. Thirteen papers were communicated, of which the following may be noticed:—Tamman (Göttingen, formerly Yurieff), determination of molecular weight of crystalline bodies; Zelinski (Moscow), absorption of ultra-violet oscillations by radio-active substances; Romanoff (Moscow), absorption of electromagnetic waves by alcohols; Kolli (Moscow), photochemical action of electromagnetic waves on a mixture of benzene and toluene; Hollmann (Yurieff), thermodynamics of solutions; Lazareff (Moscow), diffusion and biological processes.

(2) Section of Physics.—Of the twenty-six papers presented at seven meetings, many dealt with advances of physics during recent years and new fundamental conceptions. Among the papers were:—Weinberg (Tomsk), slow deformations of solids; Goldhammer (Kazan), theory of dispersion and absorption of light in isotropic immobile bodies; Arkadieff (Moscow), magnetic properties of iron and nickel under the influence of swift electrical oscillations; Ehrenfest (St. Petersburg), on the existence of æther; Roshdestvenski (St. Petersburg), anomalous dispersion in sodium vapours; Timiriazeff (Moscow), viscosity of rarefied gases; Kravetz (Moscow), constitution of absorption bands in transparent media.

(3) In the Section of Radio-telegraphy six papers, mostly of a technical nature, were communicated in three meetings. A joint meeting with the Section of Applied Physics was held in the Polytechnic Institute, where three communications were made:—Chernysheff (St. Petersburg), absolute measurements of high voltage; Müller (St. Petersburg), production of electromagnetic waves in a system of three communicating conductors.

(4) The Section of Geophysics met on seven occasions,

when sixteen communications were made and discussed. Many are of general interest:—Voeikoff (St. Petersburg), the influence of water on the heat balance of the earth; Vernadski (St. Petersburg), gaseous interchange in the earth's crust; Tochidlovski (Odessa), formation of the elements of fog; Aganin (Odessa), new hypothesis of formation of thunderstorms; Dubecki, actinometric observations at the glacier of Berel. In the joint meeting of this section and the Section of Physics four communications were presented. Prince Golitzin (St. Petersburg) gave an account of the actual state of seismology, and Rosenthal (Warsaw) spoke about the determination of the depth of the origin of earthquakes.

(5) Considerable interest was taken in the Section of Astrophysics; in three meetings eleven papers were read. Of these we mention:—Amaftunski (Vilna), theory of sunspots as resulting from the activity of prominences; Tikhoff (Pulkovo), on the scintillation of stars; light-filters applied to the study of physical properties of Mars and Saturn; optical properties of solar prominences; Donich (St. Petersburg), astrophysical investigation of complete solar eclipses; Neuimin, advances of selenium-astrophotometry; Arzikhovski (Novocherkassk), spectra of planets obtained by Slipher, and the spectrum of chlorophyll.

Many papers were also read at meetings of the sections of metallography and technical electrochemistry; aërodynamics; biochemistry and biophysics; agricultural chemistry; hygiene; and didactics, the last-named being devoted to methods of teaching physics and chemistry in colleges (gymnasiums), and kindred matters.

The exhibitions of physical and chemical apparatus were very successful, and many foreign firms took part in them (viz. A. Hilger, C. Zeiss, Heraeus, Füss, and others). In spite of the cold (on some days a temperature of $-25°$ was registered), more than sixty excursions were made to different works and institutions of St. Petersburg and its environs. Almost all museums were open to the members of the congress, and the provincial members made the most of this occasion to acquaint themselves with the capital. After the end of our congress many members took part in the Congresses of Applied Geology and Mathematics, which were inaugurated in St. Petersburg on January 9.

RELATION BETWEEN HEIGHT AND LENGTH OF THE WAVES FINALLY PRODUCED AT SEA BY WINDS OF ANY GIVEN SPEED.[1]

OBSERVATIONS made by the author, and those of Scoresby, Paris, Abercromby, and others, show that when the waves in a storm are fully developed they travel with the same speed as the wind which produces them. If there be any excess velocity of wind, such as might be supposed necessary to prevent the waves from flattening out through the effect of friction, it is a quantity so small that it falls within the errors of observation. Similarly for the breakers which reach our coasts after storms in the Atlantic, the author has recorded periods which show a deep-water velocity equal to the maximum recorded velocity of the wind during the same spell of weather, the latter being in one case Beaufort's force 11, or 64 statute miles per hour, and in another case Beaufort's 12, or 77 statute miles per hour. He has never recorded breakers with a speed equal, or nearly equal, to the speed which the wind momentarily attains in gusts, the speed of the waves not exceeding the average speed of the wind. The observations indicate that if there be any waves which travel faster than the wind, they do not attain sufficient amplitude to form breakers.

Since the highest waves finally produced travel with the same speed as the wind, their period and length can be at once precisely calculated for any given speed of wind. The recorded heights of fully developed waves for all weathers, from "strong breeze" to "strong gale," 25 to 44 statute miles per hour, are proportional to the speed of the wind, the multiplier being 0·7. Thus the height of the waves finally produced in a strong breeze, such as that of the trade winds, is $25 \times 0·7 = 17·5$ feet, and in the ordinary "strong gale" of the North Atlantic $44 \times 0·7 = 30·8$ feet. The length of the waves being precisely calculable from the speed of the wind, their flatness can be calculated by dividing by the empiric number for height. The ratio of length to height is thus proportional to the velocity of the wind, the multiplier being 0·6.

Description of wind.	Beaufort's number for wind-force.	Velocity of wind (V) in statute miles per hour =Velocity of wave.	Period in seconds $=V \div 3·493$.	Length in feet $=V^2 \div 2·382$.	Height in feet $=V \times 0·7$	Length ÷ Height $=V \times 0·600$.
Strong breeze ...	6	25	7·2	262	17·5	15·0
Moderate gale ...	7	31	8·9	404	21·7	18·6
Fresh gale ...	8	37	10·6	575	25·9	22·2
Strong gale ...	9	44	12·6	813	30·8	26·4
Whole gale ...	10	53	15·2	1180	37·1	31·8
Storm	11	64	18·3	1720	44·8	38·4
Hurricane ...	12	77	22·0	2489	—	—

The author recently obtained measurements of large waves in unusually favourable circumstances, the ship, P. and O. ss. *Egypt*, being hove-to for nine hours in the Bay of Biscay during the storm of December 21, 1911. The following velocities of wind are the means of two sets of estimates of the Beaufort's number. At 4 a.m., velocity of wind, 48·5 statute miles per hour; 8 a.m., 46·5; noon, 35·5. The velocities of the waves were:—8 a.m., 47 statute miles per hour; 10 a.m., 43·5; noon, 39·5. At 10 a.m. the prevailing height of wave was 31 feet, very few being lower. There was no "swell," *i.e.* no waves longer and flatter than these, neither were there any noticeable short waves. This remarkable "sea" was the effect of a very strong wind upon a heavy swell already running in precisely the same direction. The speed of this swell, as observed in the positions occupied by the ship on the preceding day, was 40 statute miles per hour. Its height was usually about 15 feet, individual crests rising occasionally to a little more than 20 feet.

[1] Summary of a Cantor lecture delivered before the Royal Society of Arts on January 22 by Dr. Vaughan Cornish.

QUANTITATIVE STUDIES IN EPIDEMIOLOGY.

THE publication of a paper on this subject by Sir Ronald Ross in a recent issue of NATURE[1] prompts me to present a note which I had been holding over for a longer article, and have also incorporated in a paper read before the Washington Philosophical Society.[2] At the same time, I wish to offer a solution for a certain system of differential equations obtained by Sir Ronald Ross—a solution which presents certain points of interest.

I.

We may set ourselves the problem of investigating the relation between the number of the infected population (the focus of infection), the total population, the "infectiousness" of the disease, and its mean duration. We shall here restrict our considerations to the case of a disease such as pulmonary phthisis, which is more or less constantly present (*i.e.* not epidemic in its occurrence). Brief reflection shows that we can apply to this case a mathematical treatment precisely analogous to that of the growth of a population; for we may think of the diseased portion of the population as a separate aggregate, into which new individuals are recruited by fresh infections, just as new individuals enter an ordinary population by procreation. On the other hand, members are continually eliminated from the aggregate, first by deaths, secondly by recoveries. On the basis of these considerations, formulæ can without difficulty be established between the

[1] October 5, 1911, p. 466.
[2] November 11, 1911: "Evolution in Discontinuous Systems." Published in the Journal of the Washington Academy of Sciences, January and February, 1912.

factors enumerated above. Such general formulæ, however, involve certain functions which are unknown, and the determination of which by statistical methods would at best present great difficulties. The matter assumes a somewhat more favourable aspect if we are satisfied with the discussion of the simple special case of a stationary population in which the disease also is supposed to have reached equilibrium.

We may then proceed as follows:—

Let N be the total number of the population, and N_1 the number afflicted with the disease.

Let $S = Ns$ be the total number of deaths per unit of time, and let $S_1 = N_1 s_1$ be the number of deaths per unit of time due to the disease considered.

Let $N_1\sigma_1 = N_1\frac{s_1}{\tau}$ be the total number of individuals eliminated from the aggregate of diseased persons per unit of time from all causes, including deaths by the disease under consideration, by other diseases, and also recoveries.

When a stationary condition is reached, σ_1 must be equal to the reciprocal of the mean duration L of the disease.

In this case we have, then,

$$N_1 s_1 = N_1\frac{\tau}{L} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Furthermore, if γ is a factor indicating that fraction of the total deaths which is due to the disease considered, then

$$N_1 s_1 = N_1\frac{\tau}{L} = \gamma N s \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Hence

$$\frac{N_1}{N} = \frac{\gamma L s}{\tau} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

or, solving for L,

$$L = \frac{N_1}{N}\frac{\tau}{\gamma s} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

By the way of a numerical example, I will substitute in the formula thus obtained some data gathered from the statistics of New York City. The supposition of a stationary population and equilibrium condition of the disease is quite unwarranted here, but in the absence of more suitable material, and in view of the great uncertainty of the figures obtainable, we shall have to rest content with this very crude illustration.

In 1909 the population of New York numbered about 4·5 millions. The total number of consumptives at the time has been estimated at about 45,000. Hence $\frac{N_1}{N} = 0{\cdot}01$. The death-rate per head per annum from all causes was 0·016; that from tuberculosis alone, 0·002. Hence

$$s = 0{\cdot}016$$
$$\gamma s = 0{\cdot}002$$
$$\gamma = 0{\cdot}125.$$

The coefficient τ represents a measure of the "deadliness" of the disease—*i.e.* it expresses what fraction of the persons once struck with the disease ultimately die therefrom. It is difficult to obtain any kind of estimate of the value of τ. We will assume that $\tau = 0{\cdot}8$.

We then have by (4)

$$L = \frac{0{\cdot}01 \times 0{\cdot}8}{0{\cdot}002} = 4.$$

In view of the crudity of the data on which it is based, this calculation must be regarded purely as an illustration of the principles involved, and not in any sense as an attempt to determine L, although the endeavour has been made to preserve at least the right order of magnitude in the example given.

II.

In dealing with metaxenous diseases, Sir Ronald Ross obtains the equations

$$\frac{dz}{dt} = k'z'(p - z) + qz \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

$$\frac{dz'}{dt} = kz(p' - z') + q'z' \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

He points out that

$$\frac{az}{dt} = \frac{dz'}{dt} = 0$$

when

$$z = \frac{kk'pp' - qq'}{kk'p' - kq} = A \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

$$z' = \frac{kk'pp' - qq'}{kk'p - k'q'} = A' \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Let us introduce new variables

$$Z = z - A \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$
$$Z' = z' - A' \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

Equations (5), (6) then appear in the form

$$\frac{dZ}{dt} = aZ + bZ' + cZZ' \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

$$\frac{aZ'}{dt} = a'Z + b'Z' + c'ZZ' \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

where the coefficients a, a', b, b', c, c' are functions of k, k', p, p', q, q'. If these latter are constant, the solution of (11), (12) can immediately be written down in series form, namely,

$$Z = A_1e^{-ht} + B_1e^{-Ht} + A_2e^{-2ht} + B_2e^{-(h+H)t} + C_2e^{-2Ht} + A_3e^{-3ht} + B_3e^{-(2h+H)t} + C_3e^{-(h+2H)t} + D_3e^{-3Ht} + \ldots \quad . \quad (13)$$

and a similar series for Z'. The constants of these series can be evaluated by substituting the solution in the original equations and equating the coefficients of homologous terms of the right-hand and left-hand member. In particular, we thus obtain

$$h = -\tfrac{1}{2}\{(a + b') + \sqrt{(a - b')^2 + 4a'b}\} \quad . \quad . \quad . \quad . \quad (14)$$
$$H = -\tfrac{1}{2}\{(a + b') - \sqrt{(a - b')^2 + 4a'b}\} \quad . \quad . \quad . \quad . \quad (15)$$

This result throws an interesting light on the character of the path by which the final "static" condition is reached; the process is oscillatory so soon as

$$(a - b')^2 + 4a'b < 0$$

The solution (13) is then preferably written in trigonometric form,

$$Z = e^{-mt}(P_1\cos nt + Q_1\sin nt) + e^{-2mt}(P_2\cos 2nt + Q_2\sin 2nt + R_2) + e^{-3mt}(P_3\cos 3nt + Q_3\sin 3nt + R_3\cos nt + S_3\sin nt) + \ldots \quad (16)$$

with a similar series for Z'. It will be observed that for large values of t both Z and Z' follow the law of damped harmonic oscillation, with a common period, and a phase difference depending on the value of the constants a, a', b, b'.

In conclusion it may be remarked that Sir Ronald Ross's equations (5) and (6) can still be solved by the method here set forth if the coefficients k, k', p, p', q, q' of those equations are not constants, but functions of z and z'. The right-hand members of equations (11) and (12) are then obtained as Taylor's series for two variables, and thus extend to an infinite number of terms. This does not in any way affect the form of the solutions (13), (16), which remain valid also in these circumstances.

ALFRED J. LOTKA.

NATIONAL SYSTEMS OF EDUCATION.[1]

THE International Council of Women has issued a special pamphlet entitled "National Systems of Education," which ought to prove useful to educationists and to the large body of voluntary workers who interest themselves in educational progress. The pamphlet comprises short accounts of the leading features of education in the various countries or States represented within the International Council of Women—United States, Canada, Germany, Sweden, Great Britain and Ireland, Denmark, Netherlands, New South Wales, Victoria and Queensland in Australia, Tasmania, New Zealand, France, Switzerland, Austria, Hungary, Norway, Belgium, Greece, Russia, Finland, Italy, Servia, and Bulgaria.

These accounts have been contributed by the members of

[1] First Report of the Education Committee of the International Council of Women, compiled by Mrs. Ogilvie Gordon, Convener. Pp. 94. (Aberdeen, Rosemount Press.) Price 6*d*.

the education committee in response to a series of questions framed by the convener, Mrs. Ogilvie Gordon. Among the writers are such well-known experts as Mme. Pauline Kergomard, Government inspectress in France; Miss Florence Keys, of Bryn Mawr College, in the United States; Miss Ellen Terserus in Sweden; Miss L. Sandholt in Denmark; Miss Augusta Rosenberg in Hungary; Dr. E. Graf in Switzerland; Dr. I. Grassi in Italy; Frau Marianne Hainisch in Austria.

The lines of the inquiry have been adhered to by all the contributors, and this has secured a directness and simplicity in the method of treatment that will specially commend the pamphlet to the non-professional reader. It also facilitates a comparison of the different stages of advancement reached by one country and another, in any particular department of education.

We find, for example, that primary education is obligatory in all these countries, with the exception of Russia, Finland, and some parts of Canada. In Russia, elementary education is not compulsory. The number of schools is at present restricted, and can by no means accommodate all the children. In European Russia, 43 per cent. of the men and 21 per cent. of the women can read and write. The numbers attending the elementary schools are 3,882,883 boys and 1,517,260 girls. The towns are much better provided with schools than the rural districts. Primary education is free. The schools are chiefly under the control of the local government bodies, but there are several thousand church schools. The pupils of the primary schools are taught reading and writing, arithmetic, and religion. In Finland, the question of compulsory education is the question of the moment. However, most people can read, as there is a law (1686) which enacts that all Lutherans who desire to marry must be able to read. The Canadian report says:—"There is a movement in Montreal to secure a compulsory school law there. In Nova Scotia each municipality decides for itself whether attendance of children at schools shall be compulsory or not. . . . In poor, thinly settled districts, where the inhabitants make their living by fishing, lumbering, &c., there is still much illiteracy, and very little interest is taken in securing educational advantages for children."

Religious instruction in accordance with the established church of the country is compulsory in the primary schools of Germany, Austria, Hungary, Sweden, Denmark, Russia, Finland, and Greece. In Belgium and Switzerland, if the parents wish, the children are allowed to absent themselves from religious teaching. In Norway "religious instruction is compulsory except for dissenters' children." In the Netherlands the "public elementary schools do not undertake religious instruction, but, by arrangement, instruction may be given in the schools by all denominations." In the United States "no specific religious instruction of any kind is admitted in the public schools, elementary or secondary."

When we compare the period during which attendance at the primary schools is obligatory, we find that it is longest in Great Britain, where, normally regarded, the school age is from five to fourteen years. Next come Austria, Hungary, Switzerland, Germany (except Bavaria and Würtemberg, where the age is six to thirteen), with eight years' attendance, from six to fourteen, certain exemptions being permitted, especially in rural areas. On the other hand, these are the four countries where all boys are compelled to attend continuation classes after leaving the primary school, up to fifteen years of age in Switzerland and Hungary, and sixteen years in Munich and a number of industrial centres in Germany and Austria. In France, attendance is compulsory from six to thirteen years of age; in Norway and Denmark, from seven to fourteen years; in Belgium and the Netherlands, from six to twelve years.

In Sweden, the usual period of attendance is from seven to fourteen years of age, but exemptions at twelve years are freely allowed among the poorer children for wage-earning purposes, delicacy of health, or entry on skilled trades. If they remain until fourteen or fifteen years of age, the boys and girls are given more advanced and specialised work, much in the same way as in the supplementary schools or classes in Scotland.

The public elementary schools of Sweden are described as co-educational, but it has to be remembered that in the larger public schools the boys and girls are taught separately in several of the branches, after ten years of age. For example, cardboard sloyd and elementary needlework are taught as a three years' course to mixed classes of boys and girls between seven and ten years of age. Afterwards the boys and girls are taken separately; both continue cardboard sloyd until about eleven and a half years of age, but the girls are also taught from ten years onward more advanced needlework and household subjects, while the boys in these years pass through stages of wood-carpentry and metalwork.

The system of trade schools and day continuation classes is only beginning in Sweden. There are "compensation" evening schools, compulsory for the children of twelve or thirteen years of age, who are exempted from the primary schools, and there are voluntary evening schools for older pupils. Almost every Swedish town supplies a good business training in the evening schools.

One striking inequality in Sweden is that the State provides for boys a complete secondary- or high-school education at public schools which are practically free, whereas girls have to depend upon private enterprise, and pay fees accordingly. Also in Denmark "all the secondary schools for girls alone are private schools, but recently in Copenhagen a few secondary classes for girls have been established in the public schools (municipal or State grammar schools)."

Frau Steinmann writes of the provision of secondary schools for girls in Germany:—"The higher schools for girls are those towards which the women of our country are chiefly directing their attention at present. Until lately they were 'higher' schools mostly in the sense that they were attended by the higher classes, the instruction being no other than in a 'middle school.' Recently they have been much improved, an advancement due to the influence of women's associations; but still (with the exception of Saxony) they are not preparatory for any public examination, and cannot be regarded as on the same level as the higher schools for boys. . . . The majority of these schools, probably 75 per cent., are private schools; only a small proportion are public schools."

The note of progress in girls' education is clearly sounded by Mme. Kergomard for France:—"Secondary education for girls is proving a remarkable success in our country. Scarcely begun, it can already count its institutions in almost all the chief towns in the 'departments' (there called lyceums), and in almost all the chief places in the 'districts' (there called colleges and secondary courses). These courses, which were started with a view to the general culture and higher education of girls, are being naturally and irresistibly directed towards the diplomas, and no longer towards diplomas of a limited kind, known as 'women's diplomas,' which are looked down upon in the universities, but towards the full licentiate and fellowship degrees as for men.

"The study of dead languages has gradually been organised in the secondary schools; we declare that we no longer wish for 'equivalents,' any more than we are willing to accept an inferior place in the university. . . . The universities are open to women, thanks to the system of recognising some branches of study in lieu of the men's programme; but we wish to discard all 'equivalents,' as they deprive us of the right to teach in these universities."

Among other European countries, Switzerland has already gone a long way in adapting the higher education of girls to the needs of the universities, and assimilating, with certain reservations, the gymnasial courses for girls to the courses in boys' gymnasia. Servia has lately been making very rapid strides in her educational system, and every advancement is shared alike by boys and girls:—"Most girls whose parents can afford it, and especially in recent years, attend the girls' gymnasia, which are founded on exactly the same system as those for boys. The cost of education in the gymnasium for boys is 20 francs in the lower classes and 40 francs in the higher classes; for girls the cost is 25 francs per annum in the lower and 45 francs in the higher classes.

"*Commercial academies* have lately been opened for boys and girls; some are co-educational, others are special schools for boys or for girls. Pupils are only admitted to these academies after having passed through four classes of a gymnasium and obtained the corresponding certificate.

The academy then provides a three years' course in commercial subjects, and grants a diploma which enables the outgoing scholars to enter upon banking, accounting, and other mercantile and commercial careers."

Of secondary education in Russia, her Excellency Mme. Philosophoff writes:—"In the Russian Empire there are 689 ordinary secondary schools for boys and 605 for girls; the numbers in attendance are 149,438 boys and 194,506 girls. There are, moreover, special secondary schools, technical, commercial, artistic, &c., which are attended by 163,053 boys and 46,911 girls. . . . The schools usually have the right to give the pupils who pass the final examination a diploma. In the boys' high schools for classics this diploma opens the way to the university. Pupils of 'Realschulen' must pass an additional examination in Latin. Girls who have passed through a girls' high school may be admitted to the private university colleges or medical colleges for women, but not to the universities. Women were admitted to the universities in 1905, 1906, and 1907, but the right was then withdrawn. The syllabus of work in the high schools for girls is much the same as in the classical high schools for boys, except that it does not include Latin."

For complete equality of opportunity in an education that shall be preparatory either to the university or to various forms of professional careers not demanding a university diploma, one turns to the United States:—"Both the elementary and the high schools are absolutely free to residents. To non-residents a small fee is charged, averaging according to locality. Practically all institutions above the secondary schools offer scholarships and fellowships, awarded on various grounds, to students in undergraduate and in graduate work.

"The majority of the high schools are co-educational, though in large centres segregated high schools are also maintained by the public-school system. . . .

"A phenomenal expansion has recently been witnessed in agricultural, technical, and vocational training. Great progress in agriculture has been attained by the universities, notably that of Wisconsin, and agricultural high schools have been opened in many localities. The first vocational public school was opened in New York City, September, 1909. Technical and trade schools have been opened in many cities, and technical instruction is also offered by cooperation between manufacturers and local school boards. Business colleges are numerous throughout the country, and the university curriculum at certain institutions has been extended to include courses in railroad administration, consular service, business methods, &c."

Miss Keys comments upon the promise of usefulness given by the Carnegie foundation for the advancement of teaching:—"During the five years of its existence (organised 1905), in its function as a pensioning body for the faculties of colleges and universities, it has investigated the curricula and teaching equipment of such institutions with a view to determining their eligibility to benefit by the pension fund. The result of such investigations and the subsequent publication and free circulation of findings have thus far been of indubitable advantage to sound educational methods. Notably has this been the case in connection with the report on the medical schools of the United States and Canada: the facts there published have been instrumental in closing some of the least defensible of these schools and in profoundly modifying for the better schools well-meaning but ill-equipped. Thus far, then, the foundation, by the ideals and methods of those conducting it, has happily contradicted the apprehensions of those educators who saw in it a possible agent for formalising the higher institutions of learning, and thus retarding progressive development."

The question that deals with universities, university colleges, and polytechnic institutions has elicited an interesting series of responses. In the United States these number 606, and only 89 of them are under the control of the State or of municipalities, 517 being under private corporations. The autonomous government of the private colleges has given rise to the notorious want of uniformity in the degree standards throughout the States, and to certain of the inadequacies which have been exposed by means of the Carnegie foundation.

In Canada the larger universities, such as the Toronto University, the McGill University at Montreal, and Dalhousie University at Halifax, are co-educational. "Several new universities are being started in the West (one at Saskatoon, another in British Columbia), and they will probably have an important educational influence on that part of the Dominion. . . . The fees payable at Canadian colleges are usually small, and the cost of living is moderate, except in the larger cities, such as Montreal and Toronto."

Germany has now thrown its universities and polytechnic institutions entirely open to women, with the exception of the Roman Catholic theological faculties. "Women may take the same degrees as men in medicine, philosophy, and science. In law they may take the degree of a Doctor in Law, but most States do not allow them to pass the examination demanded for a lawyer, and none to enter the Civil Service. In theology, some Protestant faculties allow women to take their university degree (Lic. Theol.), but none to pass the examination leading to church service. . . . Literary, professional, and scientific societies generally admit women of university rank, yet not all do so. The cost of university education is very different. It may be fixed between 400 marks and 1000 marks (ca. 20*l.* and 50*l.*) a year, residence and board not included."

Sweden also excludes women from the licentiate in theology, but permits them to attend the lectures. All other degrees are the same for men and women. "According to an Act of Parliament passed last year, *all careers are open to women graduates*, except in the faculty of theology and the army and navy medical posts in the faculty of medicine. Women of university rank are eligible for all societies upon the same terms as men of university rank. All university instruction in Sweden is *free*. There are *a great many bursaries* offered to students of small means. Students who are under training as teachers are offered no special facilities."

Norway, Denmark, and Servia are other States in which university instruction is given without any payment of class fees. In the Netherlands the cost of university teaching is 16*l.* 3*s.* 4*d.* per annum during the first four years; in Switzerland it is about 300–400 fr. annually; in Austria the minimum is 40 kr. a semester, or half-session, and the maximum is 100 kr. a semester for the ordinary student in the faculty of philosophy; in medicine, the ordinary fees are 100 kr. a semester in the first and second years, and 200 kr. a semester in the third, fourth, and fifth years. In Russia the cost is 10*l.* to 12*l.* annually. In New South Wales the cost is as much as 25*l.* to 30*l.* annually. Thus there are great differences in the expenses of a university education, but in every country there are scholarships and bursaries for deserving students.

The educational conditions in Great Britain and Ireland have been ably described by the Hon. Mrs. Franklin, who represents the National Union of Women Workers (or British National Council) upon the International Council of Women.

The information gathered together in this very inexpensive pamphlet is full of suggestion, and if the pamphlet succeeds in making for itself a circulation, there is little doubt but that the various contributors will be encouraged to amplify their statements at a future date, and to reissue this trustworthy record of educational conditions and advances from time to time. The International Council of Women is undoubtedly fulfilling its high ideals in placing its world-organisation, at present presided over by the Countess of Aberdeen, at the service of the public in such ways, and it is sincerely to be hoped that every encouragement will be given to the disinterested work of the council in the cause of education.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. J. B. Hurry, of Reading, has offered to present to the University securities adequate for the endowment of a research studentship in physiology of the value of 100*l.*, tenable for one year, and available every two years. He suggests that the holder of the studentship should bear the title of "Michael Foster Research Student," in memory of one who did much for the

establishment of the biological and medical schools at Cambridge.

The General Board of Studies has reported in favour of establishing a lectureship in experimental morphology, and should the report be adopted it asks for powers to appoint C. Shearer, of Clare College, subject to the confirmation of the Special Board for Biology, as the lecturer for a period of five years.

Applications for the John Lucas Walker studentship, the holder of which shall devote himself (or herself) to original research in pathology, are invited, and should be sent, before February 19, to Prof. G. Sims Woodhead, Pathological Laboratory, New Museums, Cambridge, to whom also applications for further information regarding the studentship may be addressed. The studentship is of the annual value of 200*l*. (grants may also be made for assistance and apparatus), and is tenable for three years from April 18.

The Special Board for Biology and Geology reports that the Gordon Wigan income for 1911 has been applied as follows:—(*a*) 50*l*. to Prof. Hughes, being 40*l*. for a motor for driving a rock-slicing machine and 10*l*. for the forwarding of Pleistocene research; (*b*) 50*l*. to Prof. Punnett in order that the Botanic Garden Syndicate may continue to offer special facilities for plant-breeding experiments; (*c*) 50*l*. to Prof. Gardiner for the care and development of the collections of insects.

OXFORD.—The Weldon memorial prize has been awarded to Prof. Karl Pearson, F.R.S. This prize was founded in memory of the late Prof. Weldon, and is awarded to the person who, in the judgment of the electors, has during the last six years published the most noteworthy contribution to biometric science.

Dr. Merry, Rector of Lincoln College, has addressed a letter to the Vice-Chancellor in which he says that the college is now in a position to respond to the appeal made some time ago for help to the University in the way of contribution to the endowment of some of the professorships. A fellowship in the college has been offered to and accepted by the professor of pathology (Prof. G. Dreyer).

Sir E. Ray Lankester, K.C.B., F.R.S., Mr. M. E. Sadler, Vice-Chancellor of Leeds University, and the Duke of Northumberland, K.G., F.R.S., have been elected honorary students of Christ Church.

A REUTER message reports that Sir Charles N. E. Eliot, K.C.M.G., formerly Commissioner and Commander-in-Chief for the British East Africa Protectorate, and Vice-Chancellor of the University of Sheffield, has been nominated principal of Hong Kong University.

A SERIES of nine free popular lectures is being given in the new lecture hall of the Horniman Museum, Forest Hill, S.E., at 3.30 o'clock on Saturday afternoons. The lectures commenced on Saturday last, when Dr. H. S. Harrison, curator of the museum, lectured on "A Museum of Evolution."

WE learn from *Science* that the will of the late Mrs. E. H. Hitchcock provides that the Hitchcock mansion and the estate of forty-five acres, valued at 10,000*l*., shall go to Dartmouth College. To the Howe Library of Hanover, occupying the ancestral home of Mrs. Hitchcock, an endowment of 10,000*l*. is left. To the Pine Park Association, a society formed to preserve the natural beauties of the town, is bequeathed a large tract of woodland adjoining the Vale of Tempe.

THE fellowship of the City and Guilds of London Institute has been conferred upon Mr. Noel Deerr and Mr. Leonard P. Wilson. This distinction is conferred upon students who, having obtained the associateship and spent at least five years in actual practice, produce evidence of having done valuable research work or of having otherwise contributed to the advancement of the industry in which they are engaged. Since Mr. Noel Deerr gained his associateship at the City and Guilds (Engineering) College he has been occupied as chemist to cane-sugar factories, and has rendered signal services to the cane-sugar industry. Since Mr. Leonard P. Wilson gained his diploma he has held the Leathersellers' Company's research fellowship. He is now a chemist at one of the artificial silkworks at Coventry. His work in connection with the artificial silk industry has been of special value.

A COPY of the report of the Librarian of Congress and the report of the superintendent of the library building and grounds for the year ending June 30, 1911, has been received from Washington. In the internal affairs of the library the record of the year shows rather a steady progress along lines now well established than any novelty of importance, except the more systematic and extended distribution of copyright duplicates to other Federal libraries. The library has recently been the beneficiary of two bequests from Europe. One, in 1910, was by the late Mr. Henry Harrisse, an American long resident in Paris, the cartographer and historian of the period of Columbian discovery; the other, in May, 1911, by the late Dr. A. B. Meyer, director of the Dresden Museum of Zoology, of the letters of Prof. F. Blumentritt, of Leitmeritz, on account of the many items of information relating to the Philippines. We notice that the grants to the library in 1911 amounted to 133,400*l*., and that the expenditure during the same period reached 131,000*l*.

THE future of the London Institution has been under the consideration of the board of the institution for some time. The Government has been approached on the question of the inauguration of a scheme to utilise the institution as a school of Oriental languages. At a meeting of the board, held on February 1, it was decided to issue a circular to the proprietors of the institution reviewing the situation and enumerating proposals for founding the London Institution for Oriental Languages. The circular was published in *The Times* of February 2, and we notice that it is proposed to provide, say, 20,000*l*. to 25,000*l*. by grants from Government, and an annual income, towards which the Government has agreed to contribute 4000*l*. a year. It is also proposed to transfer to the new governing body, or to the Government for the use of the new governing body, the freehold property of the institution and all other property of the institution, except its funds at present invested in Consols. It should be pointed out that in order to carry the proposals into effect an Act of Parliament will be required, but as the proposals meet with the approval of the Government, it is not anticipated that this would be a matter of difficulty.

A FEW months ago reference was made in these columns to a movement to ensure that a girl's education should include some knowledge of the science which affects home problems and some practice in the domestic arts. To give practical effect to the views then expressed, it was necessary for a university to open its doors to special courses for training women in the study of the science of the household, and thus ensure for schools a continual supply of teachers trained to impart the knowledge on which the necessary reforms must be based. King's College for Women had made a most successful start in educating women on these lines, but the movement could not be carried on successfully without adequate endowment. The sum of 100,000*l*. was needed—20,000*l*. to provide a hostel for the practical training in domestic arts and as a residence for women students, 20,000*l*. for building and equipping laboratories, and 60,000*l*. for the endowment of salaries for professors and lecturers. A trust fund committee was formed to receive moneys given for this purpose, and the announcement is now made that the whole of the 100,000*l*. required has been subscribed privately in the course of a few months. The Marquis of Anglesey gave 20,000*l*. to build and equip the laboratories, and another 20,000*l*. was given anonymously to found the hostel, which her Majesty has allowed to be called Queen Mary's Hostel. Mrs. Wharrie gave a sum of 20,000*l*. to provide for the teaching of chemistry, in memory of her father, the late Sir Henry Harben, and when it was known that yet 30,000*l*. was required, another donor, who had already by his influence rendered splendid service to the movement, at once came forward and gave this amount to complete the endowment. The fund will be administered in accordance with the terms of the trust deed by an executive committee composed of representatives of the subscribers and of King's College for Women, including Lady Meyer and Lady Rucker, who were the pioneers of the scheme. Negotiations are now proceeding respecting a site for the hostel and for the new buildings of King's College for Women, in which will be incorporated the laboratories of the home science department.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. A. **Harden** and Dorothy **Norris**: The bacterial production of acetylmethylcarbinol and 2 : 3-butylene glycol from various substances. *B. lactis aërogenes* and *B. cloacae*, when grown in a peptone solution containing either glucose, lævulose, mannose, galactose, arabinose, isodulcite, or adonitol, produce both acetylmethylcarbinol and 2 : 3-butylene glycol. Glycerol, ethylene glycol, and acetaldehyde under similar conditions also give rise to butylene glycol in presence of *B. lactis aërogenes*, but no acetylmethylcarbinol is produced. In these three cases a carbon synthesis is involved analogous to that which occurs in the butyric fermentation of glycerol and lactic acid. The fermentation of citric and malic acids, of dihydroxyacetone, and of peptone water gives rise to neither carbinol nor glycol.—J. **Thompson**: The chemical action of *Bacillus cloacae* (Jordan) on glucose and mannitol. The *B. cloacae*, like *B. lactis aërogenes*, produces a considerable proportion of 2 : 3-butylene glycol from glucose and mannitol, as well as a small amount of acetylmethylcarbinol. The other products are alcohol, acetic, lactic, formic and succinic acids, carbon dioxide, and hydrogen. As in the cases of *B. lactis aërogenes* and *B. coli communis*, the percentage of alcohol produced from mannitol is about double that formed from glucose.—J. H. **Mummery**: The distribution of the nerves of the dental pulp. The object of the paper is to demonstrate, with the author's preparations, that the nerve fibres of the dental pulp do not terminate, as considered by most histologists, at the pulp margin, but that, although they here form a narrow plexus, fine neurofibrils pass out from it in great abundance and enter the dentinal tubes, traversing the dentine in intimate association with the dentinal fibrils to the inner margin of the enamel and cementum. The bundles of medullated nerve fibres which enter the tooth at the apical foramen traverse the pulp in more or less parallel lines, running in most cases in company with the blood vessels. They send off numerous side branches, which at the periphery of the pulp lose their medullary sheath, the axis cylinders spreading out into a mass of neurofibrils which enter into a more or less dense plexus beneath the odontoblast layer. These neurofibrils are more abundant towards the crown of the tooth, and are scattered and nearly absent in the lower part of the root. Fine fibrils are met with in the substance of the pulp, but in much greater abundance at the margins, in the neighbourhood of the odontoblast layer. At the periphery of the pulp these fibres break up into a plexus, known as the plexus of Raschkow, immediately beneath the layer of odontoblast cells. From this plexus fine neurofibrils pass between and around the odontoblasts, enclosing them in a meshwork and entering into a narrow plexus at the inner margin of the dentine, from which fine fibres are given off to the dentinal tubules. In the substance of the dentine in well-impregnated preparations fine dotted lines can be traced in the tubules. In the majority of cases there appear to be two fibres in each tubule. These dotted lines can be traced in many preparations to the inner margins of the enamel and cementum.—F. W. **Twort** and G. L. Y. **Ingram**: A method for isolating and cultivating the *Mycobacterium enteritidis chronicae pseudotuberculosae bovis* (Jöhne), and some experiments on the preparation of a diagnostic vaccine for pseudo-tuberculosis of bovines. In 1910 the authors demonstrated the possibility of obtaining a pure growth of Jöhne's bacillus on a medium containing the powdered substance of the dead human tubercle bacillus. This medium was suggested by the possibility that previous failures in attempts to cultivate the micro-organism of Jöhne's disease had resulted from an inability on the part of the bacillus to build up some necessary part of its food material, and that this part might be supplied ready formed in the bodies of the dead tubercle bacilli. During the past year the authors have tested the growth of Jöhne's bacillus on media modified by substituting 1 per cent. of other dead acid-fast bacilli in place of human tubercle bacilli. They have experimented with seventeen varieties, and have obtained positive results with a large number, but negative results with others, including the bovine tubercle bacillus. These experiments demonstrate a hitherto unrecognised difference between the human and bovine types of tubercle bacilli. The authors have also succeeded in extracting, by means of hot ethyl alcohol and other solvents, the essential substance (existing in the various acid-fast bacilli) which is needed by Jöhne's bacillus for its vitality and growth. The strains of Jöhne's bacillus which they have isolated have been inoculated into a number of animals, with negative results in the case of rabbits, hens, pigeons, guinea-pigs, rats, and mice, thus furnishing further proof that Jöhne's bacillus is not a variety of the human, bovine, or avian tubercle bacillus. The inoculation of calves and a cow with strains of bacilli isolated from cases of pseudo-tuberculous enteritis has reproduced the disease with its typical characteristics, and the bacilli have been again isolated from the artificially infected areas, and show the characters of the bacilli originally inoculated. Avian tuberculin, originally recommended by Bang, of Copenhagen, for the diagnosis of Jöhne's disease, has in the authors' hands given negative results. They have prepared diagnostic and other vaccines from their pure cultures of Jöhne's bacillus, but so far have been unable to obtain a diagnostic vaccine of sufficient strength. As the bacillus is now growing more vigorously, the authors hope to overcome this difficulty in the near future.—E. A. N. **Arber**: The fossil flora of the Forest of Dean Coalfield (Gloucestershire) and the relationship of the coalfields of the west of England and South Wales.—Dr. F. W. **Edridge-Green**: Simultaneous colour contrast. (1) The colours and changes of colour which are seen on simultaneous contrast appear to be due to the exaggerated perception of objective relative difference of the contrasted lights. Whilst all the known contrast phenomena are easily explicable on this view, there are many facts which are opposed to the older theories. For instance, spectral yellow or pigment yellow contrasted with green do not appear red when seen through a blue-green glass, which is impervious to the red rays. (2) A certain difference of wave-length is necessary before simultaneous contrast produces any effect. This varies with different colours. (3) A change of intensity of one colour may make evident a difference which is not perceptible when both colours are of the same luminosity. (4) Simultaneous contrast may cause the appearance of a colour which is not perceptible without comparison. (5) Both colours may be affected by simultaneous contrast, each colour appearing as if moved further from the other in the spectral range. (6) Only one colour may be affected by simultaneous contrast, as when a colour of low saturation is compared with white. (7) When a false estimation of the saturation or hue of a colour has been made, the contrast colour is considered in relation to this false estimation. That is to say, the missing (or added) colour is deducted from (or added to) both. (8) A complementary contrast colour sensation does not appear in the absence of objective light of that colour.—Prof. H. E. **Armstrong** and E. **Horton**: Studies on enzyme action. XIV.—Urease, a selective enzyme.

Linnean Society, January 18.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. A. Anstruther **Lawson**: Some features of the marine flora at St. Andrews.—Miss E. L. **Turner**: Discovery of a nestling bittern in Norfolk on July 8, 1911. Slides were shown from photographs taken by the author, and they showed the young bird in its protective attitude simulating a bundle of reeds, and the nest itself.

Mineralogical Society, January 23.—Prof. W. J. Lewis, F.R.S., president, in the chair.—Miss M. W. **Porter** and Dr. A. E. H. **Tutton**: The relationship between crystalline form and chemical constitution; the double chromates of the alkalies and magnesium. The investigation of the crystals of ammonium-magnesium chromate containing $6H_2O$, and of those of the analogous salts containing rubidium and cæsium (the formation of the corresponding potassium salt being impossible), shows not only that the double chromates belong to the same monoclinic series as the double sulphates and selenates previously investigated by Dr. Tutton, but that their mutual relationships are precisely parallel to those afforded by the other groups of the series. The rubidium and cæsium salts exhibit the

same progressive changes of morphological and physical properties in the same direction as the rubidium and cæsium salts of all the other groups investigated, so that if the potassium salt could be prepared the three salts would undoubtedly form a eutropic group progressive in properties in accordance with the atomic weights of the three alkali metals, and it is even possible to predict the properties of the missing potassium salt. As in all the other cases, the ammonium salt is isomorphous, and not eutropic. Moreover, the double chromates are isomorphous and not eutropic with the eutropic sulphates and selenates.—Prof. W. J. **Lewis**: A lead-grey sulpharsenite from Binn, probably liveingite. The crystals have two prominent zones mutually inclined at 90°, the one markedly oblique and the other prismatic in symmetry. Assuming oblique symmetry, the face-symbols are very high numbers; assuming anorthic symmetry, they are simple, but the crystals possess several relations characteristic of oblique symmetry, and twinning, though undoubtedly occurring, is not a satisfactory explanation.—R. H. **Solly** and Dr. G. F. H. **Smith**: A new anorthic mineral from the Binnenthal. Since no further crystals have come to light similar to the five minute ones found in 1902 by Mr. Solly on a crystal of, probably, rathite, they have recently been remeasured. They are lead-grey, and their streak is chocolate in colour, and they are therefore probably a sulpharsenite of lead. No axes or plane of symmetry were observed, and the symmetry is therefore anorthic. The fundamental constants are $a:b:c=0{\cdot}9787:1:1{\cdot}1575$; $\alpha=116^\circ\ 53\frac{1}{2}'$, $\beta=85^\circ\ 12'$, $\gamma=113^\circ\ 44\frac{1}{2}'$; $010:001=62^\circ\ 41'$, $001:100=83^\circ\ 4\frac{1}{2}'$, $100:010=65^\circ\ 46'$; and about twenty-one forms were observed, of which the most prominent are 100, 010, 001, $\bar{1}10$, $1\bar{1}1$, $11\bar{1}$.—Dr. A. **Hutchinson**: Colemanite and neocolemanite. By a slight change in the orientation adopted for the crystals of the latter mineral, its crystallographic and optical properties can be brought into harmony with those of the former. This can be effected by a rotation of the crystal through 180° about the normal to the face 001, 100 of neocolemanite then coinciding with $\bar{2}01$ of colemanite.—Dr. A. **Hutchinson** and Dr. A. E. H. **Tutton**: Further observations on the optical characters of gypsum. With the aid of new apparatus, by which the section-plate of gypsum perpendicular to the first median line can be surrounded during observations of the interference-figure by flowing hot water, of which the temperature is accurately recorded both immediately before and after passing the crystal, the authors have been able to prove definitely that the temperature at which gypsum becomes uniaxial is for sodium light 91°, for red C and greenish-blue F hydrogen light 89°, and for the violet hydrogen line near G 87°. These temperatures agree precisely with those observed for the exact superposition of the pair of images of the spectrometer slide, afforded by a 60° prism cut to give the α and β refractive indices. Owing to the large correction necessary for conduction of the crystal holder, when the ordinary Fuess air-bath heating apparatus was employed, and to the difficulty in determining it, former determinations of the temperature at which a section-plate of gypsum becomes uniaxial were too high, and did not agree with the prism observations.—Dr. G. F. H. **Smith**: Note on a large crystal of anatase from the Binnenthal. The crystal exhibits a combination of the forms $a(100)$, $\tau(313)$, and $z(113)$, and the others not prominent, and it is remarkable for the fact that the faces τ have been entirely replaced by numberless tiny crystals with the forms $z(113)$, $k(112)$, $p(111)$, and $e(101)$, and the same orientation as the large crystal.

Geological Society, January 24.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. C. A. **Matley**: The Upper Keuper (or Arden) Sandstone group and associated rocks of Warwickshire. The stratigraphy of a sandstone zone in the Keuper Marls of Warwickshire, well exposed in the area formerly occupied by the Forest of Arden, is described. This zone varies in lithological composition and thickness. It is never wholly a sandstone, but always contains beds of light grey and pale green shale, marl, and mudstone. The sandstone usually forms thin, flaggy, white or light grey beds, and exhibits ripple-marks, current-bedding, and surfaces with footprints and suncracks. The zone contains *Estheria minuta*; plants; teeth, spines, and scales of fishes; tracks and remains of labyrinthodonts and reptiles; and occasional casts of molluscan shells. The zone was first described by Murchison and Strickland in 1837, but has not hitherto been completely mapped. The author traces it from the type-locality at Shrewley over an area of 108 square miles, and finds that it forms a continuous deposit at an horizon between 120 and 160 feet below the base of the Rhætic. He accepts the view of Murchison and Strickland, and he also correlates with it the similar deposit at Leicester described by Plant. The formation was probably formed, as an episode in the history of the Keuper Marls, by an irruption of the sea into the Keuper Marl area. It represents a phase corresponding to that of the Rhætic bone-bed and the tea-green Marls, but of somewhat earlier date. The author is inclined to the view of the older observers that the Marls are aqueous deposits, though possibly containing much wind-borne material, deposited in a shallow lake undergoing strong evaporation and subjected to occasional irruptions of the sea. They represent the closing phase of Triassic "continental" conditions in the English Midlands, when the slow subsidence which was soon to bring in marine Rhætic and Liassic deposits was in progress, and produced that overlapping of the Keuper rocks on to the higher grounds of the Triassic land-surface which is observable in the neighbouring districts of the Lickey Hills, Nuneaton, and Charnwood Forest. The paper also records three well-borings through the Marls into the Lower Keuper Sandstone.

Physical Society, January 26.—Prof. H. L. Calnelard, F.R.S., president, in the chair.—R. **Appleyard**: A direct reading instrument for submarine cable and other calculations. The logarithmic spiral has frequently been used for determining by a graphic method the logarithm of the ratio of two quantities. If an attempt is made to apply the spiral to the solution of engineering problems, such as arise in the design of submarine cables, there is difficulty in obtaining sufficient accuracy, especially for readings near the pole of the spiral. This defect has been removed by introducing a secondary spiral, similar in all respects to the primary spiral, and having the same pole, but displaced round the pole through a certain constant angle. A pair of radial scales, each having its zero at the pole, and each divided into the same number of equal divisions, can be rotated about the pole. At all angular positions a scale of this kind will be cut by the two spirals if they are sufficiently extended. For all angular positions of such a radial scale the distance between the pole and the point where that radial scale is cut by the secondary spiral is always the same multiple of the distance between the pole and the point where the radial scale is cut by the primary spiral. In effect, the secondary spiral magnifies the radial scale readings of the primary spiral to any desired extent, depending only upon the angle through which the template of the primary spiral is rotated to form the secondary spiral. The spirals are drawn in a manner that avoids ambiguous readings, and give maximum precision within the range of diameters of conductors and dielectric coverings required for submarine cable work. The instrument is provided with two similarly divided radial scales, one corresponding to d, the diameter of the conductor, and the other corresponding to D, the diameter of the dielectric. The angle between the two scales, corresponding to any pair of values of d and D, is then a measure of $\log D/d$. The scales can be marked to indicate weights of conductor and dielectric, and the circle of degrees to which the spiral is drawn can be marked to indicate $\log D/d$, capacity, dielectric resistance, and other functions of D and d, if required, for any definite dielectric, the specific constants of which are known. The general equation to the spiral may be written $\theta=A\log d+B$, where A and B are constants. To draw the secondary spiral, the primary spiral is rotated backwards about its pole through an angle ϕ. This is equivalent to rotating both the radial scales through ϕ. The intercepts are now d_1 and D_1—*i.e.* the radial scale readings are now greater in the ratio $n=\frac{d_1}{d}=\frac{D_1}{D}$.—S. **Butterworth**: The vibration galvanometer and its applications to inductance bridges. Vibration galvanometers are divided into two types, according as their moving parts possess only one or an infinite

number of degrees of freedom. A theory of the former type of galvanometer when used in circuits containing inductance and capacity is worked out, and the conditions of maximum sensibility are determined. The same theory is applicable to the string type of galvanometer provided that the damping is small. The results are applied in the case of a general inductance bridge: (*a*) Anderson's bridge, (*b*) a modified Rimington's bridge, (*c*) Heydweiller's modification of the Carey-Foster bridge, and (*d*) a bridge for measuring frequency. The best conditions for working Anderson's bridge with the vibration galvanometer as detector are obtained. Experimental results for methods (*b*) and (*d*) are quoted.—Dr. P. E. **Shaw**: Sealing-metals. The established method of fixing quartz fibres for accurate torsion experiments is due to Prof. C. V. Boys. It involves considerable trouble, which can be avoided by the means given, while the resulting joint is in some cases stronger. Prof. Threlfall used Margot's solder to fasten glass, aluminium, or quartz surfaces to any other. This material acts perfectly, and is simple, the bit being of aluminium, and there being no flux. Investigation shows that there is no special merit in Margot's formula. In place of Margot's solder the following act very well:—(*a*) tin; (*b*) zinc; (*c*) alloys of tin and zinc; (*d*) tinman's solder; (*e*) aluminium. Lead does not stick well. Then there is a variety of materials with melting point ranging from 180° to 660°. For all materials which act in the same manner as sealing-wax the term sealing-metals is suggested. They have the advantages over any wax in (*a*) high melting point, (*b*) non-emission of vapour when temperature is raised. There are applications other than for tension fibres where joints to withstand temperature are required.—Dr. J. H. **Vincent** and A. **Bursill**: A negative result connected with radioactivity. Specimens of iron, antimony, and bismuth were subjected to a high-frequency alternating magnetic field. The air in the neighbourhood was tested for any ionisation that might have been thus produced. The results were negative.—Prof. A. **Anderson**: A copper-zinc uranium oxide cell and the theory of contact electromotive forces. A uranium oxide cell with copper and zinc plates is described, and reference is made to the temperature coefficient of its E.M.F. A difficulty connected with the energetics of the cell is pointed out, and a possible explanation put forward tentatively.

Royal Anthropological Institute, February 6.—D. **MacRitchie**: The kayak in north-western Europe. The kayak, or skin canoe of the Eskimos, was in use on the coast of northern Russia two or three centuries ago. Evidence of this is obtained from statements made by Burrough in 1556, and from the chronicles of a Danish expedition to Vaigatz in 1653. It appears that the natives of that coast not only used the ordinary kayak, constructed to hold one person, but also built kayaks capable of holding two occupants, a variety of this canoe which is nowadays specially associated with western Alaska and the Aleutian Isles. It was further shown that three kayaks were captured off the northern shores of Scotland about the end of the seventeenth century. One of these is still preserved in the museum of Marischal College, Aberdeen. An important fact is the occasional presence of a kayak-using race of "Finns" or "Finnmen" in the Orkney Islands during the last twenty years of the seventeenth century, as testified to by three writers of that period. The Orkney people being of Norse stock, the word "Finn" would bear to them the meaning of the Swedish "Lapp." It is consequently worthy of note that the mountain Lapps have a tradition that their ancestors crossed into Sweden from Denmark in small skin boats, and that the only Lapp name for a boat denotes a skin canoe, propelled by paddles, and devoid of rowers' seats and steering place. The comparatively recent survival of Lapp communities in southern Norway was also referred to. After considering the theories of castaways from Greenland, and of Eskimos brought captive to Europe who had subsequently regained their freedom, the lecturer expressed himself in favour of the hypothesis that the Orkney "Finnmen" of the seventeenth century, like their kayak-using contemporaries on the north Russian coast, were the unassimilated remnants in Europe of people of Eskimo type, whose range in earlier times had been wholly circumpolar.

Manchester.

Literary and Philosophical Society, January 23.—Prof. F. E. Weiss, president, in the chair.—Thomas **Thorp**: A crossed transparent grating. The secondary spectra produced by the crossing of the gratings are quite pure and free from all "scatter."—J. R. **Gwyther**: The modes of rupture of an open hemispherical concrete shell under axial pressure. The author gave an account of tests carried out with nine specimens he had prepared, made of concrete in the proportion of 1 : 1½ : 2, the aggregate being ¼-inch chippings, and the results obtained by subjecting these shells in the ordinary way to compression in a horizontal testing machine. "Longitudinal" cracks in meridional planes first appeared, spreading gradually, and the shells ultimately broke by an irregular crack roughly along a parallel of "latitude," the mean height being approximately 0·6 the height of the shell. The vertex of the cone of fracture roughly coincided with the centre of the base. In the plain specimens the "longitudinal" cracks began at the base; in the specimens reinforced at the base they commenced at the top; and in the specimens reinforced both at the base and the top they commenced around the middle of the shell. Mr. Gwyther concluded that the "ring tension" was comparatively small, that the fracture depended on the load and not the stress, and that the final rupture was due to an excessive "bending moment." He gave a table he had prepared showing the vertical breaking loads in tons and breaking stresses in pounds per square inch.—R. F. **Gwyther** read a note on the mechanical conditions involved in the foregoing question

Dublin.

Royal Irish Academy, January 23.—Rev. Dr. Mahaffy, president, in the chair.—H. **Ryan** and T. **Dillon**: Higher tertiary alcohols derived from palmitic and stearic esters. Some discrepancies between theory and experiment in the analysis of beeswax suggested an examination of the properties of higher tertiary alcohols, but as substances of this class have been, with one exception, hitherto unknown, it was necessary to attempt their synthetical preparation. Good yields of higher tertiary alcohols were obtained by the action of alphyl and aryl magnesium halides on the esters of palmitic and stearic acids. By dropping concentrated sulphuric acid into a hot solution of a higher fatty acid in alcohol a second liquid phase, consisting of the nearly pure esters, forms, and hence, rapidly and quantitatively, the fatty acid is converted into its ester. The method is an extremely convenient one for the preparation of such esters. The tertiary alcohols formed esters with acetyl chloride, but with acetic anhydride and sodium acetate mixtures of esters and unsaturated hydrocarbons were obtained. Phenyl isocyanate did not form urethanes with them, and when they were heated with potash-lime to 230° C., unlike the corresponding primary alcohols, they underwent no change.—A. **McHenry**: Report on the Dingle Bed rocks. It is suggested by the author that the seeming conformable succession on the south is due to inversion and overthrusting of the rocks, and that the true position of the "Dingle Beds" in the geological succession is at the bottom of the Upper Silurians, and that they are probably of Llandovery age; while on the north and north-east sides of the fossiliferous Silurian inlier, the rocks there, called "Smerwick Beds" on the Survey map, are the equivalents in age to the "Dingle Beds," and come in their true and regular order below the Wenlock division of the Silurians. The exact similarity of the "Dingle Beds" and "Smerwick Beds" in all their characters is very apparent in the field, and was even noticed by Du Noyer when surveying the district more than fifty years ago. The author has no doubt of their being the one set of strata, and probably of Llandovery age.—Rev. Canon **Lett**: Mosses and hepatics (Clare Island Survey). A total of 272 mosses and 140 hepatics were found in the district, of which 27 mosses and 22 hepatics occurred on the island only, and 95 mosses and 42 hepatics on the mainland only. Eight hepatics were hitherto unknown in Ireland, while *Scapania nimbosa* and *Riccia serocarpa* had previously only one station in the country (South Kerry).—Miss G. **Lister**: Mycetozoa (Clare Island Survey). In the Clare Island district 31 species were found during a visit last November

Advantage is taken of this report to summarise our knowledge of this group in Ireland. Some 65 species in all are on record from the country, but about six of these are regarded as probably erroneously recorded.—Carleton **Rea** and Sir H. C. **Hawley**: Fungi (Clare Island Survey). Previous to the present survey only two species of fungi were on record for the county of Mayo. Some 750 species are now recorded, of which nearly 300 are new to the Irish flora. One new genus of Hyphomycetæ—Candelospora, Hawley—and one new Agaric—*Hygrophorus squamulosus*, Rea—are described. On Clare Island itself a list of 284 species of fungi was compiled.—A. W. **Stelfox**: Land and fresh-water Mollusca (Clare Island Survey). This group was closely studied not only on Clare Island, but along the whole coast of Mayo, and on the adjoining islands of Inishtusk, Caher, and Inishbofin, and analyses of the faunas of the different parts of the area are made. In the whole district 90 species of Mollusca were found. Of these, 58 occur on Clare Island, two of which are looked on as owing their introduction to man.

EDINBURGH.

Royal Society, January 8.—Dr. John Horne, F.R.S., vice-president, in the chair.—Dr. **Kidston** and Prof. Gwynne **Vaughan**: The Carboniferous flora of Berwickshire. Part i. *Stenomyelon tuedianum*, Kidst. The description was founded on a specimen found by the late Mr. Matheson, Jedburgh, in 1859, and additional material found in the original locality in 1901. Briefly put, it is as follows:—stem monostelic, primary xylem without xylene parenchyma, divided more or less distinctly into three lobes by as many radiating and interrupted bands of parenchyma; primary tracheæ porose on all walls, the protoxylems of the leaf traces decurrent as exarch strands on the extremities of the lobes; secondary thickening occurs, secondary tracheæ with porous pith on radial walls only; medullary rays numerous; stele closely invested by a zone of sclerotic periderm; leaf traces depart successively from the extremities of the lobes and repeatedly divide in the cortex; leaf-trace protoxylems become immersed; the outer cortex of the "Spargonum" type. The stem possesses so many features peculiar to itself that in the present state of our knowledge it is unsafe to speculate as to its relationship to the other members of the Cycadofilices. It is perhaps best to let it remain among that nebulous group in which it has already provisionally been placed by Dr. Scott. At the same time, it should be noted that the absence of independent meristeles in the cortex of the stem separates it widely from *Sutcliffia insignis*, Scott, with which one might be tempted to compare it.—Dr. F. J. **Cole**: A monograph on the general morphology of the myxinoid fishes, based on a study of Myxine. Part iv. On some peculiarities of the afferent and efferent branchial arteries of Myxine. These peculiar structures are called vascular papillæ, and have been found in some cases to be the means by which blood is passed direct from the arteries into the surrounding "lymphatic" peribranchial sinuses. Such blood re-enters the blood stream *via* the superior jugular veins. The so-called lymphatic spaces of Myxine contain normally red blood, and therefore must be excluded from the lymphatic system *sensu stricto*. They are, however, not situated directly in the course of the blood stream, but partake of the nature of both systems. The Myxinoids are in the act of acquiring a definite lymphatic system.—Prof. Sutherland **Simpson**: The effect of changing the daily routine on the diurnal rhythm in body temperature. Experiments were made on the daily variation in body temperature during travel across the American continent and across the Atlantic Ocean. It was found that the body quickly adjusted itself to the new conditions, so that the diurnal rhythm depended entirely on the daily routine.—Prof. David **Hepburn**: The Scottish National Antarctic Expedition. Observations on the Weddell seal. Part ii. The paper gave an account of the genito-urinary organs of a young *Leptonychotes weddelli*, captured and embalmed by the naturalist of the Scottish Antarctic Expedition. A detailed account was given of the following special points:—the adaptation of the pelvic organs to the great obliquity of the osseous pelvis; the allantoidal shape of the urinary bladder, which extended as far forwards as the umbilicus; the presence of prostatic glandular tissue, as revealed by the microscope; the presence of a cylindrical piece of developing bone common to both corpora cavernosa penis; the absence of a scrotum, and the lodgment of each testis in a subcutaneous recess showing no surface bulging; the absence of vesiculæ seminales; the presence of a bilateral retractor penis muscle composed of unstriped muscle fibres, probably representing the tunios dartos of the absent scrotum.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts iv. and v. for 1911, contain the following memoirs communicated to the society:—

June 17.—K. **Wegener**: The *rôle* of direct radiation in the temperature-period of the air at low and middle altitudes of the troposphere.—A. **Bestelmeyer**: The path of the kathode rays proceeding from a Wehnelt kathode in a homogeneous magnetic field.

July 1.—E. **Landau**: The partition of numbers compounded of ν prime factors.—K. **Försterling**: Formulæ for the computation of the optical constants of a metallic film of given thickness from the polarisation conditions of the reflected and transmitted light.

July 29.—H. **Bohr**: The behaviour of the zeta function $\zeta(s)$ in the half-plane $\sigma > 1$.—C. **Runge**: Graphical solution of the boundary conditions of the equation

$$\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0.$$

—P. **Bachmann**: Materials for a scientific biography of Gauss: (i) on Gauss's work in the theory of numbers.

September 14.—Th. v. **Kármán**: The mechanism of the resistance experienced by a moving body in a liquid.

October 13.—R. **Fricke**: The transformations of automorphic functions (dedicated to Richard Dedekind on his eightieth birthday).

October 28.—G. **Tammann**: Equations of condition in a region of small volume.—R. **Wedekind**: Contributions to the knowledge of the Upper Devonian series at the northern margin of the slate ridge (Schiefergebirge) on the right bank of the Rhine.

The Business Communications (part ii.) include a discourse on "Metamorphic Processes in the Crystalline Slates," by O. **Mügge**, and congratulatory addresses to Prof. Waldeyer, and to the Universities of Breslau, Christiania, and St. Andrews.

BOOKS RECEIVED.

The Practical Science of Billiards and its "Pointer." By Colonel C. M. Western. Pp. iv+153. (London: Simpkin and Co., Ltd.) 3*s*. 6*d*. net.

The University of Missouri Studies. Vol. ii. Science Series:—The Flora of Boulder, Colorado, and Vicinity. By Prof. F. P. Daniels. Pp. xiii+311. (University of Missouri.) 1.50 dollars.

A Shorter Geometry. By C. Godfrey, M.V.O., and A. W. Siddons. Pp. xxii+301. (Cambridge University Press.) 2*s*. 6*d*.

South African Zoology. By Prof. J. D. F. Gilchrist. Pp. xi+323. (Cape Town: T. Maskew Miller.) 10*s*. 6*d*. net.

Fortschritte der Naturwissenschaftlichen Forschung. Edited by Prof. E. Abderhalden. Vierter Band. Pp. 299. (Berlin & Wien: Urban & Schwarzenberg.) 15 marks.

The Arctic Prairies. A Canoe-journey of 2000 Miles in Search of the Caribou; being the Account of a Voyage to the Region North of Aylmer Lake. By E. Thompson Seton. Pp. xvi+415. (London: Constable and Co., Ltd.) 12*s*. 6*d*. net.

Practical Anthropology. By T. E. Smurthwaite. Pp. 40+2 charts. (London: Watts and Co.) 2*s*. 6*d*. net.

A School Chemistry. By F. R. L. Wilson and G. W. Hedley. Pp. xxii+572+diagram. (Oxford: Clarendon Press.) 4*s*. 6*d*.

Social Life in the Insect World. By J. H. Fabre. Translated by B. Miall. Pp. viii+327. (London: T. Fisher Unwin.) 10*s*. 6*d*. net.

How Other People Live. By H. Clive Barnard. Pp. 64. (London: A. and C. Black.) 1*s*. 6*d*.

An Elementary Text-book of Coal Mining. By R. Peel. Sixteenth edition. Pp. 386. (London: Blackie and Son, Ltd.) 3s.

A New Geometry. By W. M. Baker and A. A. Bourne. Books i.–iii. Pp. xxii+122+iii. (London: G. Bell and Sons, Ltd.) 1s. 6d.

Heat and the Principles of Thermodynamics. By Dr. C. H. Draper. New and revised edition. Pp. xv+428. (London: Blackie and Son, Ltd.) 5s. net.

The Prescribing of Spectacles. By A. S. Percival. Second edition. Pp. v+168. (Bristol: J. Wright and Sons, Ltd.) 5s. 6d. net.

The Problems of Philosophy. By the Hon. B. Russell, F.R.S. Pp. 255. (London: Williams and Norgate.) 1s. net.

Anthropology. By R. R. Marett. Pp. 256. (London: Williams and Norgate.) 1s. net.

Our Weather. By J. S. Fowler and W. Marriott. Pp. xi+131. (London: J. M. Dent and Sons, Ltd.) 1s. net.

Modern Theories of Diet and their bearing upon Practical Dietetics. By Dr. A. Bryce. Pp. xv+368. (London: E. Arnold.) 7s. 6d. net.

Tables of Logarithms and Anti-logarithms (Four Figures), 1 to 10,000. Arranged by Major-General J. C. Hannyngton. Pp. iv+41. (London: C. and E. Layton.) 1s. 6d. net.

Tables of Logarithms and Anti-logarithms to Five Places. By E. Erskine Scott. Students' edition. Pp. iii+383. (London: C. and E. Layton.) 5s. net.

A Nature Calendar. By Gilbert White. Edited, and with an Introduction, by W. M. Webb. Pp. xii+62+xiii–xx. (London: The Selborne Society.) 25s. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—The Spectrum of Comet Brooks (1911*c*): Sir Norman Lockyer, K.C.B., F.R.S.—A Chemically-active Modification of Nitrogen produced by the Electric Discharge. III.: Hon. R. J. Strutt, F.R.S.—The Atomic Weight of Radium: R. Whytlaw-Gray and Sir W. Ramsay, K.C.B., F.R.S.—The Emission of Electricity from Carbon at High Temperatures: Dr. J. A. Harker, F.R.S., and Dr. G. W. C. Kaye.—The So-called Thermoid Effect and the Question of Superheating of a Platinum-silver Resistance used in Continuous-flow Calorimetry: Prof. H. T. Barnes, F.R.S.—An Optical Determination of the Variation of Stress in a Thin Rectangular Plate subjected to Shear: Prof. E. G. Coker.—Spectroscopic Observations. Lithium and Cæsium: Dr. P. V. Bevan.—A Metrical Analysis of Chromosome Complexes, showing Correlation between Evolutionary Development and Chromatin Thread-widths throughout the Animal Kingdom: Capt. C. F. U. Meek.

ROYAL INSTITUTION, at 3.—The Phenomena of Splashes: Prof. A. M. Worthington, C.B., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—High Voltage Tests and Energy Losses in Insulating Materials: E. H. Rayner.

ROYAL SOCIETY OF ARTS, at 4.30.—The North-East Frontier of India: Sir Thomas H. Holdich, K.C.M.G., F.R.S.

CONCRETE INSTITUTE, at 8.—Discussion on Prof. B. Pite's paper: The Æsthetic Treatment of Concrete.

MATHEMATICAL SOCIETY, at 5.30.—On Exceptions to a Generalisation of a Theorem of Jacobi's: A. C. Dixon.—On some Properties of Groups whose orders are Primes: Prof. W. Burnside.—Some results concerning Diophantine approximations: G. H. Hardy and J. E. Littlewood.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 9.—Very High Temperatures: Dr. J. A. Harker, F.R.S.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Desert of North Africa: Captain H. G. Lyons, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steam-turbines: Some Practical Applications of Theory: Captain H. Riall Sankey, R.E.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address: Prof. A. Schuster, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting. Presidential Address: On the Lower Tertiary Mollusca of the Fayum province of Egypt: R. Bullen Newton.

ASSOCIATION OF CHEMICAL TECHNOLOGISTS (at Battersea Polytechnic), at 8.—The Structure of Metals: Dr. J. C. Humfrey.

MONDAY, FEBRUARY 12.

ROYAL SOCIETY OF ARTS, at 8.—The Meat Industry. The Sheep and its Products: Loudon M. Douglas.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Papua: Hon. Miles S. Smith.

TUESDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Desert of North Africa: Captain H. G. Lyons, F.R.S.

SOCIETY OF DYERS AND COLOURISTS, at 8.—New Apparatus for the Control of Water Purification and like purposes: Hon. R. C. Parsons.—Water Treatment by means of the Permutit Process: Dr. L. H. Harrison.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion:* The Water-supply of the Witwatersrand: D. C. Leitch.—Investigations Relating to the Yield of a Catchment-area in Cape Colony: E. C. Bartlett.

WEDNESDAY, FEBRUARY 14.

ROYAL SOCIETY OF ARTS, at 8.—Gem Engraving: Cecil Thomas.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting.—Distribution of Early Bronze Age Settlements in Britain: O. G. S. Crawford.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* A Specific Instance of the Transmission of acquired Characters—Investigation and Criticism: Dr. T. G. Brown.—Further Experiments on the Cross-breeding of two Races of the Moth *Acidalia virgularia*: W. B. Alexander.—On the Effects of Castration and Ovariotomy upon Sheep: F. H. A. Marshall.—The Causes and Prevention of Miners' Nystagmus: Dr. T. L. Llewellyn.—The Stomatograph: W. L. Balls.—Composition of the Blood Gases during the Respiration of Oxygen: G. A. Buckmaster and J. A. Gardner.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Desert of North Africa: Captain H. G. Lyons, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 9.—The Road: Past, Present and Future: Sir John H. A. Macdonald, K.C.B., F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Works for the Prevention of Coast-erosion: W. T. Douglass.

CONTENTS.

THURSDAY, FEBRUARY 15, 1912.

THE PHILOSOPHY OF SCIENCE.

(1) *Natural Philosophy.* By W. Ostwald. Translated by T. Seltzer. Pp. ix+193. (New York: Henry Holt and Co.; London: Williams and Norgate, 1910.) Price 1 dollar net.

(2) *Prolegomena zur Naturphilosophie.* By Hermann Graf Keyserling. Pp. xii+159. (München: J. F. Lehmann's Verlag, 1910.) Price 5 marks.

(1) READERS of German will remember that Prof. Ostwald published as the first volume of Reclam's series, "Bücher der Naturwissenschaft," a book which is practically a popular summary of his larger "Vorlesungen über Naturphilosophie." This little work, after special revision by the author, now appears in an American edition. Mr. Seltzer's translation is generally satisfactory, though he has left, here and there, an obscurity of diction which it is difficult to charge to the account of so clear a writer as his original.

A book in which an investigator of Ostwald's eminence gives in systematic outline his views on the aims, nature, and general methods of science is bound to exercise considerable authority over the opinions of young students and inquiring laymen. It is, therefore, a matter of considerable importance to determine whether his guidance in these subjects may be recommended with confidence. In spite of great admiration for the genius of the distinguished chemist, the reviewer is bound to record on this point an unfavourable opinion. It would be absurd to deny that the book has value. The practical wisdom and inspiration of a successful man of science inform many of its pages, and may gladly be accepted in lieu of a good deal of correctitude in logic and philosophy. Moreover, Prof. Ostwald's characteristic doctrine of "energetics" leads him in a very direct way to results—such as the limited validity of the concept of mechanism—which, though unpopular among physicists and chemists, are regarded as of great importance by all students of the philosophy of science. But outside the thirty-six pages given to the general principles of the physical sciences, the treatment of his topics seems frequently unsatisfactory. His logical and psychological analyses lack precision and thoroughness, and often suggest that on some questions of fundamental importance he accepts the views of the Mill and Spencer epoch as finally authoritative.

The pragmatism which made Prof. Ostwald's work so interesting to the late William James appears very early in the book. Strictly speaking, science is, he holds, concerned only with the prediction of future events. The "retrospective prophecy" to which Huxley attached equal importance "must take its place with other aimless activities called *play*" (p. 13). Moreover (as the last phrase indicates) even predictions of the future are not properly to be called science unless they bear directly or remotely upon the practical management of human life. At first sight this dictum would seem to confine the legitimate development of some sciences within severely narrow limits. For example, must the palæontologist prove that his studies have a bearing (say) upon eugenics before he can be admitted into the company of men of science? In anticipation of such questions, the author is obliged to argue that since we can never know completely "what kind of knowledge we shall next need . . . therefore it is one of the most important functions of science to achieve as *perfect* an elaboration as possible of *all* the relations conceivable." Thus, judged by the pragmatic test of "alikeness" upon which Prof. Ostwald lays so much stress (p. 52), his definition of the aim and scope of scientific inquiry turns out after all to be identical with the intellectualist view upon which he is so severe (p. 13).

Prof. Ostwald's preoccupation with the practical value of science—though a fault which leans to virtue's side—makes him cling to an empiricism which is, to say the least, *démodé*. In spite of an (apparently) wider definition on p. 62, the word "experience" is constantly used as synonymous with "perceive" or "perception." Concepts are simply the "coinciding or repeated parts of similar experiences"—a view which seems identical with Huxley's "composite photograph" theory of general ideas, and is open to the same criticisms. It follows that the degree of certainty reached in reasoning depends upon the number of perceptual experiences upon which the concepts are based. Thus the security of the conclusion $2+3=5$ is extremely high because the number-concepts are so extremely "general."

Starting in this way, it is not surprising that Prof. Ostwald repeats Mill's misunderstanding of the syllogism (p. 65), and restricts deduction to the comparatively small *rôle* of applying "principles . . . acquired through the ordinary incomplete induction . . . to special instances which, at the proposition of the principle, had not been taken into consideration" (p. 41). It is difficult to regard this as an adequate statement of the aim of Newton's "Principia," or of Maxwell's "Electricity and Magnetism"; yet both these treatises must be held to give a "deductive" treatment of their subject-matter. So anxious is the author to reduce all knowledge to repeated "experiences" that he holds mathematics to have been proved to be an empirical science by the fact that certain laws in the theory of numbers have been found empirically and have not yet been proved deductively (p. 56). The same ultra-empiricism seems responsible for the remarkable statement (p. 76) that the power of "a few highly developed individuals," such as Julius Cæsar, to "keep up several lines of thought" simultaneously proves that time is not necessarily to be conceived as unidimensional.

It will be seen that, in the reviewer's opinion, Prof. Ostwald's work suffers from the capital defect of misrepresenting seriously the relations between ideas and perceptual experience. It is true that no one has yet formulated an adequate account of these relations. Nevertheless no theory of science can be satisfactory unless it takes account, on one hand, of the criticisms of the inductive process which we owe to such logicians as Bradley and Bosanquet, and, on the other, of the patient, unbiassed, and penetrating researches concerning the objects of cognitive

processes which we associate with the names of Husserl, Meinong, Bertrand Russell, and others. Although he makes good use of modern views about mathematics which have a certain connection with the latter researches, yet Prof. Ostwald, from lack of sympathy or for some other reason, appears to have assimilated very little from these typically modern doctrines about the fundamentals of his subject.

(2) In his familiarity with the present situation in logical criticism and philosophy, Graf Keyserling has a manifest advantage over his scientific compatriot. For this reason the six discourses which form his latest work offer most instructive as well as attractive reading even to those who cannot accept all his contentions. He sees with perfect clearness that the central question of natural philosophy is the question how conceptual thought is related to perceptual experience—in other words, how it is that we are able to theorise successfully. To understand the problem aright we must recognise that theories deal in the first place with entities—"universals," relations, numbers, &c.—which are distinct from the entities revealed to us in physical phenomena, and yet are really quite as external to our minds, quite as "objective" as the latter. Conversely, the phenomena commonly called external are known just as immediately and as truly as the objects of thought. It follows that the *a priori* laws which regulate our "inner" experience are entitled to be called "laws of nature" equally with the sequences determined *a posteriori* among "outer" experiences. A mind capable of taking in the universe at a glance would, in fact, see, not two worlds, but one world of reality, the elements of which are knit together by a univocal necessity.

This conception of the universe admitted, it is possible to understand that perpetual miracle—the power of "prospective and retrospective prophecy" wielded by the man of science. Consider one of the most notable instances: the power to predict and reconstruct phenomena by means of Newton's laws of motion. Since mathematical thought and the spatio-temporal series of external events run their courses under a single system of laws, it is always possible that in a given instance the mathematical realities and the empirical will, to use Graf Keyserling's word (p. 44), "coincide." Suppose this relation to hold good between Newton's laws and a group of mechanical events. Then whatever consequences follow by "logical" necessity from Newton's laws must be exhibited empirically; nature is bound, so to speak, to actualise this particular series of possibilities (p. 44). This account of the matter explains why induction does *not* (as the empiricists contend) involve essentially the contemplation of numerous instances. The essence of the process is (as Prof. Bosanquet and other writers have urged) the analysis of a given phenomenon with the view of discovering the "mathematical realities" which "coincide" with the empirical observations. If the details of the coincidence can be brought to light by the examination even of a single instance predictions based upon such an examination may have the highest certainty.

It is not possible to follow here the important consequences of Graf Keyserling's views. It must suffice to say that he develops them with great ability and in a very interesting way. He finds occasion to offer illuminating criticism of the pragmatists and of writers whose works are now the centre of much attention—for example, Hans Driesch and Henri Bergson. It is not extravagant to say that by his understanding of the problems and methods, both of philosophy and of science, his lucidity and his literary charm, he produces in no mean degree the same impression as the great Frenchman. The book is one which should find a welcome in an English translation.

T. P. Nunn.

TWO INTRODUCTIONS TO THE STUDY OF EVOLUTION.

(1) *The Doctrine of Evolution: its Basis and its Scope.* By Prof. H. E. Crampton. Pp. ix+311. (New York: The Columbia University Press, 1911.) Price 6*s*. 6*d*. net.

(2) *Einführung in die Deszendenztheorie.* Fünfunddreissig Vorträge. By Prof. Karl C. Schneider. Zweite Auflage. Pp. xii+386+3 Taf. (Jena: Gustav Fischer, 1911.) Price 9.50 marks.

(1) PROF. CRAMPTON has written a careful and interesting introduction to the study of evolution in the wide sense. It consists of eight lectures given in New York to "mature persons of cultivated minds, but who were on the whole quite unfamiliar with the technical facts of natural history," and for such an audience, which is certainly widespread, the book can be strongly recommended. But even those who know a good deal of natural history may read Prof. Crampton's lectures with great profit, for although they have not perhaps the keenness which marked the author's important contribution to the theory of natural selection (his study of *Philosamia cynthia*), they are characterised by scientific restraint, by careful workmanship, and by a wide outlook. The outstanding feature of the book is that half of it is devoted to the higher reaches of the evolution-process—to the ascent of man and the establishment of human societies.

After an introductory discourse on the living organism, Prof. Crampton sets forth the evidences of evolution from comparative anatomy, embryology, and palæontology. The fourth lecture is on "Evolution as a Natural Process," and here the author avoids controversy, contenting himself with a balanced statement of the various interpretations that have been offered. He then passes to the evolution of the human species and the human races, to mental evolution, and to social evolution. These three chapters are full of fresh illustrations of great interest. The book ends up with a courageous chapter on those "evolved products" which we call (1) ethics, (2) religion and theology, and (3) science and philosophy, the author's particular point being that here also evolution proves to be real. Not only are the higher elements in human life subject to analysis, classification, and formulation, but there are natural reasons in human evolution why there should be a developing ethics, religion, theology, science, and philosophy. The author ends up finely with a statement of the practical value of evolutionist conceptions:—

"The doctrine of evolution enjoins us to learn the rules of the great game of life which we must play, as science reveals them to us. It is well to remember that a little knowledge is a dangerous thing, but because evolution is true always and everywhere, an understanding of its workings in any department of thought and life clears the vision of other realms of knowledge and action. . . . Evolution as a complete doctrine commands everyone to live a life of service as full as hereditary endowments and surrounding circumstances will permit."

After reading this admirable course of lectures, one general criticism arises in our mind—one, however, involving for its statement a longer discussion than is possible here and now. It appears to us that the author has not sufficiently analysed his "deeply grounded conviction that evolution has been continuous throughout." We wish to know more about this continuity—what it is that is continuous, and whether the continuity implies that there is an identity of causes throughout. The genetic method is certainly applicable, but do the same categories serve throughout? Is the truth with Spencer or with Bergson? It seems to us to be giving a false simplicity to the facts to conclude that "human social relations are biological relations," or that "identical biological laws, uniform in their operation everywhere in the organic world, have controlled the origin and establishment of even the most complex societies of men." It seems to us a matter for regret that a zoologist of Prof. Crampton's eminence should adopt, especially in a work of this sort, the mechanistic hypothesis without giving a statement of the other side. We are unaware that a mechanical description has been given of any complete vital operation, and if it were given we do not think that it would be what the biologist wants, for he cannot get away from the fact that the organism is a historical being.

We are only stating our opinion, but we think there is need for reconsidering, even in the light of other parts of the book, such a deliverance as this:—

"Does science teach us, then, that the ultimate elements of human faculty are carbon-*ness* and hydrogen-*ness* and oxygen-*ness*, which in themselves are not mind, but which when they are combined, and when such chemical atoms exist in protoplasm, constitute mental powers? Plain common-sense answers in the affirmative."

And this:—

"What can be the source of mentality, if it is not something brought in from the outer world along with the chemical substances which taken singly are devoid of mind? Scientific monism frankly replies that it is unable to find another origin."

Such a presentation of the old problem seems to us disappointing, especially when it comes from the country of William James and Josiah Royce.

(2) Prof. Schneider has prepared an enlarged edition of an admirable book which was reviewed in NATURE of January 10, 1907. It then consisted of six lectures introductory to the study of organic evolution, and was marked by clearness and freshness of exposition. It had also the crowning merit of being short, and was a pleasing contrast to a number of larger books of similar aim, which take a longer time to say less. In its new edition, however, it has surrendered the charm of brevity in the hope of securing other excellencies. It has become thirty-five lectures instead of six, and each lecture occupies about ten closely printed pages. What are the features of this practically new book, which, it may be noted, is not to be confused with the author's "Versuch einer Begründung der Deszendenztheorie"?

Perhaps the chief characteristic is the elaboration of the concept of "Anlagen" or primordia. The common way of looking at these as simply material structures will not stand criticism. In place of the view that morphogenetic differentiation may be interpreted in terms of the chemico-physical properties of the primordia, Schneider seeks to substitute a rehabilitation of the "idea-theory" of Plato and Goethe, with which he combines the Aristotelian-Scholastic concept of potency, "elaborated in a modern exact fashion." Another feature of the book is a judicious eclecticism. For while there is much that is personal and original throughout, such as the author's theory of vitalism, his welcome, but all too short, discussion of the importance of periodicity, his criticism of the ordinary Darwinian position, and so on, there is a praiseworthy attempt to recognise a measure of validity in the suggestions of the various schools. He pleads for less purely argumentative criticism, for a deeper inquiry into fundamental principles, for a study of biological method, and for more determined effort to get away from preconceptions which influence even the experimenters. The Lamarckian, he says, will not hear of mutations, and the Mutationist will not hear of modifications. The Darwinist rejects the psychical theory of adaptations, and the psycho-Lamarckian rejects determinants. The student of chromosomes does away with Anlagen, the "Orthogenetiker" with adaptations, the vitalist of Driesch's persuasion with vital energy, the Weismannist with the transmission of acquired characters, the Mechanist with all vitalistic principles, and so on. But all these views have factual relations, and there is a kernel of truth in each. They cannot be lumped together, but no view is as yet complete enough to dispense with the aid of others. Cooperation as well as criticism is needed among the evolutionists.

In his sketch of the evolutionism of the future, Prof. Schneider distinguishes primary or constitutive principles and secondary or auxiliary principles. The primary principles are three:—(1) The idea, which interpenetrates every organism and binds it into unity; (2) entelechy, which is "a kind of cohesion in the idea," holding the constellation of Anlagen in a specific order, a correlating, regulative, formative principle; and (3) vitality, a form of energy, like heat in the inorganic realm, which brings into material explicitness what is implicit in the idea, and includes two main factors, of assimilation, growth, and reproduction on one hand, of variation on the other.

The secondary or auxiliary principles, which represent a complication of the primary simplicity of idea, entelechy, and vitality, are of two kinds, ectogenous and endogenous. The ectogenous principles operate from without; they do not originate within the organism. They include the influence of environ-

mental changes on assimilation and the like, and the influence of psychical impulses and needs relating to the external conditions of life. In both these ways a "somation" (corresponding to a somatic modification of most authors) may arise; it is an ectogenous change in contrast to an autonomous mutation. The endogenous secondary principles, which are also called entropic, include amphimixis and death.

THEORETICAL AND PRACTICAL PHYSICS.

(1) *A Text-book of the Principles of Physics.* By Dr. A. Daniell. New and revised edition. Pp. xxv+819. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 17*s.* net.

(2) *A Textbook of Physics.* By Prof. L. B. Spinney. Pp. xii+605. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 12*s.* net.

(3) *Principles of Physics: Designed for Use as a Text-book of General Physics.* By Prof. W. F. Magie. Pp. ix+570. (London: G. Bell and Sons, Ltd., 1911.) Price 7*s.* 6*d.* net.

(4) *Treatise on Practical Light.* By Dr. R. S. Clay. Pp. xv+519. (London: Macmillan and Co., Ltd., 1911.) Price 10*s.* 6*d.* net.

(1) IT is presumably the duty of a reviewer to try in reading a text-book to take up the point of view of the students for whom it is primarily designed. This attitude it is not at all easy in many cases to assume. But the third edition of Dr. Daniell's text-book scarcely admits of doubt in this respect. Regarded from a purely physical point of view, the book undoubtedly contains much useful information, notwithstanding the fact that it is presented in a peculiarly disjointed fashion. But to propose it as being suitable for medical students seems very misleading. Those who are experienced in teaching medical students, or, at any rate, the majority of them, know with what simplicity the principles of physics must be treated. The subject is one which the students themselves think is foreign to their medical course, and the complexity of detail with which this book abounds would surely make them adhere more strongly than ever to that opinion. But apart altogether from the question of suitability for any special class of students the book is in several other respects open to serious objections. In the first place, the unfortunate tendency in many recent physical text-books of quoting unproved numerous mathematical formulæ is especially prominent in this particular case. This is, in all probability, the main cause of the disjointed nature of the text already referred to. It must be admitted, of course, that such procedure is occasionally inevitable and even desirable, but when it becomes the rule and not the exception, it encourages students to regard physics as a series of formulæ to be committed to memory, and having no logical sequence.

Further, the mode of statement is often peculiarly involved, and sometimes inexact. The latter is illustrated by the statement that "a body free to fall in vacuo would be subject to a constant downward acceleration of about 981 *cm. per sec.*, or 32·2 *feet per sec*"—a statement quite in keeping with the unconvincing way in which the distinctions between velocity and acceleration have been previously treated. The following also is surely a rather extraordinary view to express:—"Kinetic friction is accordingly not a Force; it is a Resistance or Reaction."

The present edition has a supplementary chapter on radio-activity and kindred subjects added. Attention is directed to the chief points in recent work, but the numerical data in connection therewith have scarcely been brought up to date, the old value $3·4\times10^{-10}$ E.S. being given, for instance, as the unit of electricity. The author has also adopted a uniform notation, and gives an index of symbols at the beginning of the book, but although, in this index, 10^9 is defined as being equal to 1,000,000,000, we frequently find very large numbers expressed in the uncontracted form. The arrangement of the mathematical treatment is also unfortunate from the point of view of facility in reading, being printed in small type, and from line to line, just like the ordinary text.

(2) Prof. Spinney's book will without doubt serve admirably the purpose for which it has been written. In nearly every respect it fulfils the necessary conditions. Being written for engineering and technical students entering upon a course of physics, it deals in a straightforward and logical way with the various sections into which the subject is usually divided. As is to be expected, particular prominence is given to mechanics, the principles of which are illustrated by familiar phenomena and practical contrivances. Although the mathematical treatment is intentionally limited, what is given is exact, and involves no blind learning of formulæ. Also, notwithstanding the professedly elementary character of the work, the author contrives to convey clearly the underlying principles of such subjects as surface tension, kinetic theory of gases, and polarisation of light in a way not often achieved. To each chapter is appended a series of numerical examples; the printing and arrangement of paragraphs and chapters are excellent, and the heavy type used for the more important statements is a distinct gain. The diagrams have evidently been carefully prepared, and are reproduced in a manner quite above the average. To all students desiring a thorough introduction to the science of physics, whether they be engineering students or not, this book can be unhesitatingly recommended.

(3) In some respects this book is unique. On several previous occasions have historical treatises on special parts of physics been published, but no general elementary text-book of physics based upon a historical outline has until now, we believe, appeared. The author's chief reason for adopting this mode of procedure—and it seems to be a good one—is that it directs attention to the lines upon which discovery has proceeded, and trains the mind of the reader in the processes which may lead to further discoveries. Whether this be the case or not, it is certain that the historical treatment makes the subject eminently readable, particularly to those somewhat acquainted already with the principles of physics. From the point of view of the beginner, however, difficulties might arise owing to the historical sequence necessitat-

ing the omission of practice in the application of the physical laws. These difficulties the author has to a large extent surmounted by adding to each chapter a series of worked examples, thus avoiding the introduction of them into the text. Interest is undoubtedly added to the subject by the historical setting, and it is quite possible that students may be induced to regard physics with more favour on account of it. The printing is good, but the diagrams are neither so numerous nor so well produced as they might be. As evidence of the lack in this respect, not one of the four methods of determining the velocity of light is illustrated diagrammatically.

(4) The most surprising feature of Dr. Clay's book on practical light is the fact that considerable space is devoted to pin optics. The size of the book suggests that its scope will cover experiments of a much more elaborate character. This is indeed found to be the case, repetitions by more accurate methods of the rough pin determinations being described at a later stage. As a result the book appears unequal, and the omission of the pin experiments would have been a gain rather than a loss. The ground covered is very extensive, particular attention being paid to the chapters on the compound lens, the microscope and colour, on account of the importance of their industrial applications. Colour, especially, is treated much more fully than is usually the case in text-books of practical physics, and the numerous experiments described in this connection add considerably to the value of the book. The diagrams with which the experiments are illustrated are exceedingly good, so much so that a student, having here before him the perspective view of the arrangement of apparatus, could scarcely fail to set it up correctly without other aid. It may also be pointed out that, with the exception of one, all the diagrams have been specially prepared for this work. The general arrangement of the experiments is normal and logical, and the two appendices, containing useful practical hints, are very desirable. In short, notwithstanding the rather unfortunate inclusion of pin optics referred to, Dr. Clay's book will certainly form a very useful reference work, not only for students of physics, but also for those engaged in industrial applications of the principles of light.

INDIAN FRESH-WATER INVERTEBRATES.

The Fauna of British India, including Ceylon and Burma. Edited by Dr. A. E. Shipley, F.R.S. Fresh-water Sponges, Hydroids, and Polyzoa. By Dr. N. Annandale. Pp. viii+251+v plates. Published under the authority of the Secretary of State for India in Council. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co.; Bombay: Thacker and Co., Ltd.; Berlin: R. Friedländer & Sohn, 1911.) Price 10s.

THIS volume differs in some important respects from those that have preceded it in the "Fauna of British India." It is the first of the series to be written entirely in India, and since, as the author very justly remarks, "biological research on Indian animals can only be undertaken in India," it is only fitting that a large part of the volume should be devoted to observations on the bionomics and life-history of the organisms dealt with. It is thus far more than a merely systematic monograph, and contains a great deal that is of interest and importance, not only to the special student of the Indian fauna, but also to the general biologist.

The Indian region is especially rich in fresh-water sponges. Thirty-six species, subspecies, and varieties are enumerated (including three added in the appendix), although on p. 51 the number is given as only twenty-nine, possibly because of doubts as to the systematic or geographical status of some of the forms. Of these no fewer than twenty-two have been discovered and named by Dr. Annandale, who, however, pays a generous and well-merited tribute to the pioneer work in this field of the late Dr. H. J. Carter, of Bombay.

Little is yet known as to the seasonal cycles in the life-histories of fresh-water animals living under tropical conditions, and on this subject Dr. Annandale has many interesting observations. He points out that in temperate regions the approach of winter affects most of the less highly organised inhabitants of fresh waters in the same way, leading to the production of gemmules, statoblasts, and the like, which lie dormant during the unfavourable season. In India, on the other hand, the reaction to seasonal changes is by no means identical, even in closely allied species.

"Some species flourish chiefly in winter, and enter the quiescent stage at the beginning of the hot weather (that is to say, about March), while others reach their maximum development during the 'rains' (July to September), and as a rule die down during winter, which is the driest as well as the coolest time of the year."

A striking example of specific idiosyncrasy in this respect is given in the case of two sponges, *Spongilla bombayensis and Corvospongilla lapidosa*, found in Bombay. They

"resemble one another considerably as regards their mode of growth, and are found together on the lower surface of stones. In the month of November, however, *C. lapidosa* is in full vegetative vigour, while *S. bombayensis*, in absolutely identical conditions, is already reduced to a mass of gemmules, having flourished during the 'rains.'"

The Hydrozoa dealt with consist only of two species of Hydra, Dr. Annandale's important discovery of a fresh-water medusa (Limnocnida) in streams of the Western Ghats (NATURE, August 3, 1911) having come too late to be included in this volume. One of the species of Hydra is the familiar and widely distributed *H. vulgaris*, and Dr. Annandale has much that is new to tell regarding the bionomics even of this much-studied animal. Especially interesting is the account of the way in which the larva of a small midge, *Chironomus fasciatipennis*, preys upon Hydra. The larva, which protects itself with a tubular case of silk, entangles the Hydra with a silken thread, and binds it firmly to the outside of the tube, to be afterwards devoured at leisure.

Of Polyzoa about sixteen forms are recognised. One of the most interesting is *Hislopia lacustris*,

which was formerly placed among the Cheilostomata. Dr. Annandale confirms Jullien's statement that it belongs to the Ctenostomata, and he shows that it is closely related to Arachnoidea, which was at one time cited as evidence for the marine origin of the fauna of Lake Tanganyika.

A number of misprints have escaped correction. On p. 19 the words "co-type" and "paratype" seem to have changed places, with the disastrous result that we are left in doubt as to the sense in which these terms are used throughout the volume. In the sentence, "Some of these species . . . are identical with others . . . closely related to European forms" (p. 12), "and" preceded by a comma should apparently be inserted after "with." On p. 177 it is stated that Kraepelin's classification of the Polyzoa is "less liable to criticism than that followed by Braem," where the context appears to imply that it is more so. It is not clear in what way the "force of gravity" can account for the mutual attraction of gemmules floating on the surface of water (p. 118).

THE PHYSICS OF ELECTRIC LAMPS.

Der elektrische Lichtbogen: Experimentalvortrag auf Wunsch des wissenschaftlichen Vereins zu Berlin gehalten am 11 *Januar*, 1911. By Prof. H. Th. Simon. Pp. iv+52. (Leipzig: S. Hirzel, 1911.) Price 2 marks.

Les Lampes Électriques. By Prof. H. Pécheux. Pp. 186. (Paris: Gauthier-Villars, n.d.)

PROF SIMON'S monograph is a reprint of a lecture delivered in Berlin, and gives in an interesting and consecutive form a brief summary of the principal physical aspects of the electric arc. The numerous physical phenomena presented by the arc have long afforded a most interesting field for research, and it is remarkable into how many bypaths these researches have led. Although the arc in its practical application is primarily a source of light, the most efficient which we possess, and secondarily a source of heat, neither of these aspects receives more than a very brief mention in the pamphlet before us.

It is indeed somewhat remarkable that so little attention has been given by physicists to the problem of the emission of light by the flame arc, a field of research which would seem to be of great theoretical and practical value. But for some reason or other the electrical characteristics of the arc have always appealed more to investigators, and these have been explored far more thoroughly, with valuable and interesting results. Notably the investigations of Prof. Simon himself on the telephonic arc and of Duddell on the musical arc may be referred to; these have led to the use of the arc as a source of sustained oscillation for the transmission of wireless signals, a direction in which its utility could scarcely have been foreseen.

These phenomena and their theoretical explanation will be found clearly described in Prof. Simon's little book, which, if it does not attempt to add much to our existing knowledge, summarises it well. In addition to a number of diagrams the book is illustrated by a coloured reproduction of an autochrome photograph of a flame arc, which is fairly successful considering the difficulty of the subject. The genera effect, however, is far too red.

M. Pécheux's little book forms one of the volumes of the "Encyclopédie Scientifique des Aide-Mémoire," and is a brief and well-written description of the various types of electric lamp in use. A good deal o space is devoted to the subject of the electrical characteristics, a subject which always seems attractive to writers on incandescent lamps, and has received somewhat more attention than its importance warrants. On the other hand, the amount of attention given to the light-emitting properties and efficiency is perhaps somewhat meagre.

M. S.

OUR BOOK SHELF.

Farm and Garden Rule-book: a Manual of Ready Rules and Reference. With Recipes, Precepts Formulas, and Tabular Information for the Use of General Farmers, Gardeners, Fruit-growers, Stock men, Dairymen, Poultrymen, Foresters, Rural Teachers, and others in the United States and Canada. By L. H. Bailey. Pp. xxv+587. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1911.) Price 8*s*. 6*d*. net.

THIS book affords a striking commentary on the progress of agriculture and horticulture in these latter days; whereas a generation ago the cultivator could carry all his rules and recipes in his head, he now finds such a bewildering number of possibilities open to him that, without the help of some such volume as this, he will be wholly unable to make any use of the stores of knowledge accumulated at numerous experiment stations throughout the world.

The first section shows how to use the weather map and to interpret as far as may be the weather indications; then follow directions for making observations and using them. Next comes an account of the soil, the elements of which it is composed, water statistics, and so on, and finally rules to be followed in order that fertility may be maintained. Considerable space is devoted to chemical fertilisers, as the importance of the subject warrants; in particular the farmer is shown how to calculate the fair value of a manure from its guaranteed composition, and how to convert one form of guarantee into another. Typical mixtures of manures for various crops are suggested, the range in both cases being wide, so as to ensure that the tables shall have as large a value as possible. Dates for sowing, planting, and propagating various plants in the different regions are given, followed by tables showing the number of plants that should go to one acre and also the distance apart at which the plants must be set. Several pages are devoted to the yields of field crops in the different States, wherein some very interesting and suggestive data occur. The best yield is commonly double and sometimes three times the average for a particular State, a fact which shows that there is still room for much levelling up in the farming efficiency of the cultivators, even when allowance has been made for the fact that some of the high yields are partly due to exceptional climatic conditions.

Then we get into fruit and greenhouse figures, and find tables containing such uninteresting but valuable data as the legal size of apple barrels in various States, standard dimensions of flower pots, recipes for painting hot-water pipes, making liquid putty for glazing, &c. This section ends up with a list, eighty pages long, of fungus and insect pests the grower may reasonably expect, together with a few short hints showing how each pest may be more or less controlled.

The section on live stock runs on lines similar to those adopted for crops; tables are given showing the composition of feeding stuffs, typical rations, and methods of computing variants, together with much information about the animals themselves. Altogether the book will be found very useful for reference purposes, and, as it is well indexed, it is very easily consulted.

Mineralogy. By Dr. F. H. Hatch. Fourth edition, entirely rewritten and enlarged. Pp. ix+253 (London: Whittaker and Co., 1912.) Price 4*s.* net.

IN this "fourth edition" a revision has for the first time been undertaken. The consequent doubling of its size and price is fully justified by the enhanced value of the work, which for twenty years has been handicapped by its modest size. The addition of eighty pages to the section dealing with descriptive mineralogy has allowed a much fuller treatment of the ores, this portion being trebled in length, while ore-dressing processes (electromagnetic, oil-concentration, &c.), find brief reference under properties of minerals. The portion on optical properties, formerly relegated to a couple of pages, is enlarged sevenfold, thus permitting of an explanation of double-refraction phenomena. Coupled with the fuller description of rock minerals, this renders the book of some use in microscope work. The use of the letters 𝔞, 𝔟, 𝔠 to indicate elasticity axes is regrettable, owing to the likelihood of confusion (both in writing and speaking), with the *a*, *b*, and *c* crystallographic axes; the substitution of X, Y, Z, as adopted in Iddings's "Rock Minerals," avoids this difficulty.

The arrangement of the descriptive portion under the four heads Rock-forming Minerals, Ores, Other Salts, and Gems is convenient, if inconsistent, and it is supplemented by a list of mineral species, chemically classified. We are surprised to find so small a book including among "the more important minerals" metacinnabarite, hauerite, &c. The treatment of mineral names is not always satisfactory; thus nowhere is mention made of the name kupfernickel, so commonly used as a synonym of niccolite; dialogite appears in the text as such, but in the index as diallogite. Wolfram and wolframite (though used as synonyms) are used apparently indiscriminately in the text, but are separately indexed.

The typography is good and misprints very rare (on p. 57 *statical changes* evidently means *charges*), but some illustrations of crystals, like Figs. 63 and 75, might be improved. R. F. G.

Revolving Vectors, with Special Application to Alternating-current Phenomena. By Prof. Geo. W. Patterson. Pp. vi+89. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1911.) Price 4*s.* 6*d.* net.

THIS brief but excellent little treatise can be recommended as a good introduction to the modern topic of revolving vectors, and particularly to the use of the symbolic notation in the development of the subject. It opens with a brief historical note on the discovery in 1797, by Wessel, of the use of the imaginary $\sqrt{-1}$ as an operator having a geometric function of rotation through a right angle. From this the author leads on to the treatment of complex quantities, and their use in representing harmonic motion. The latter half of the book deals with the application to alternating electric currents and other electrical matters. It is satisfactory that the author conforms to the convention adopted by the International Electrotechnical Commission in its recent session in Turin, in using the counter-clockwise sense of rotation as positive.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Contour Diagrams of Human Crania.

IN the last number of *Biometrika* (viii., 1, 2, 1911) Prof. Karl Pearson has edited and published a very valuable paper by the late Dr. Crewdson Benington on cranial type-contours. The work is based on long series of skulls of various races, *e.g.* English of the seventeenth century (from the Whitechapel Plague Pit), modern English (Royal Engineers), various Negro races from the Congo, Guanche, Egyptian, Eskimo, and the prehistoric Cro-magnon skull. For each series three typical contours are selected, viz.:—(1) a "transverse vertical," passing through the auricular points and the apex of the skull; (2) a sagittal or median section; and (3) a horizontal section through the glabella; and in each case all the individual skulls of a series are combined into a single "type" by a process of arithmetic averages. Lastly, the diagrams thus obtained are reproduced on tissue-paper, so that one may be superposed upon another, and the characteristic differences easily compared.

I venture to think that we may go a little further, and may, by a simple device, get a new series of diagrams which shall throw into still greater relief the presence and the amount of essential difference of form: for, after all, comparison of the two superposed contours is a matter of individual judgment, and there is a lack of fixity and

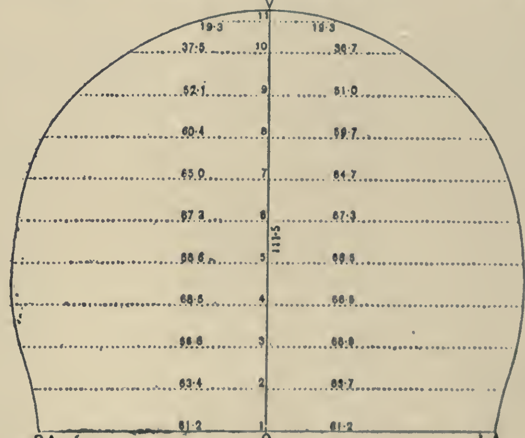


FIG. 1.—English crania, 17th century. Transverse contour.

precision in our interpretation of the result. Moreover, it is obvious that we have, in the first instance, no clear and easy distinction between differences of size and differences of form.

Taking the case of the transverse, or vertical inter-auricular, section of the skull, Dr. Benington's diagrams represent it for us as in Fig. 1, where a median vertical axis is divided into ten equal parts (the uppermost of these also by a point one-quarter of a division from the apex), and at each of these points of division the horizontal distance to the contour-line is measured and recorded. Thus we are in possession of such tabular statements as the following:—

		A	B
Vertical Height		111·5	121
Transverse diameters	11	19·3	20
	10	37·5	37
	9	52·1	55
	8	60·4	67
	7	65·0	72
	6	67·3	74
	5	68·6	74
	4	68·5	72
	3	66·6	69
	2	63·4	64
	1	61·2	62

Dimensions (in mm.) of the transverse cranial section (right side). A English skulls of 17th century; B, Cro-magnon skull.

In order to isolate differences of form from differences of general magnitude, I have reduced all measurements to the scale of a standard vertical height, of 100 mm., with the following result :—

Vertical Height ...	A 100	B 100	C 100	D 100	E 100	F 100	G 100	H 100
11 ...	17·3	16·5	18·1	18·1	16·0	12·7	15 5	17·1
10 ...	33·6	30 6	33·5	34·7	31·9	27·4	32·0	33·7
9 ...	46·7	45·5	45·5	47·5	46·0	41·6	46·0	47·6
8 ...	54·2	55·4	52·9	55·5	54·6	48·9	53·5	55·3
7 ...	58·3	59·5	56·8	58·9	59·1	54·4	56·9	58·9
6 ...	60·4	61·2	58·8	60·1	60·9	57·0	58·3	60·1
5 ...	61·5	61·2	59·5	60·3	61·7	58·2	58·6	60·4
4 ...	61·4	59·5	59·0	59·3	61·5	58·3	58·2	60·1
3 ...	59·7	57·0	57·2	57 3	59·0	57·6	55·8	57·3
2 ...	56·9	52·9	54·5	54·3	55·7	56·0	53·3	54·4
1 ..	54·9	51·2	52·0	53·3	54·5	56·0	51·4	52·5

Horizontal dimensions of the transverse cranial section, reduced to a common vertical height.

A, English (17th century); B, Cro-magnon; C, Living English; D, Egyptian; E, Guanche; F, Eskimo; G, Congo Negro (Fernando Vas, 1864); H, Congo Negro (Batetelu).

Lastly, we may write any of these in terms of percentages of any other; and so, for instance, we may take the seventeenth-century English skull as our type, and translate the data for all the rest into percentage proportions thereof, as follows :—

	A	B	C	D	E	F	G	H
11 ...	100	95·4	104·6	104·6	92·7	73·4	89·6	98·8
10 ...	100	91·1	99·7	103·3	94·9	81.6	95·4	100·3
9 ...	100	97·5	97·4	101·7	98·5	89·1	98·4	101·9
8 ...	100	102·2	96·9	102·4	100·8	90·2	98·7	102·0
7 ...	100	102·0	97·4	101·0	101·4	93·3	97·6	101·0
6 ...	100	101·3	97·3	99·5	100·9	94·4	96·5	99·5
5 ...	100	99·5	96·7	98·0	100·3	94·7	95·3	99·8
4 ...	100	96·9	96·1	96·6	100·1	95·0	94·8	97·9
3 ...	100	95·5	95·8	96·0	98·8	96·5	93·5	96·0
2 ...	100	92·9	95·8	95·4	98·0	98·5	93·7	95·6
1 ...	100	93·3	94·7	97·1	99·2	102·1	93·6	95·6
Mean ...	100	97·1	97·5	99·6	98·7	91.7	95·2	98·9

Relative horizontal dimensions of the transverse cranial section.

A, English (17th century); B, Cro-magnon; C, Living English; D, Egyptian; E. Guanche; F, Eskimo; G, Congo (Fernando Vas); H, Congo (Batetelu).

When these numbers are translated into curves (plotting heights vertically and percentage-breadths horizontally), then, I think, they show us in a striking way the nature and degree of such differences as exist between the several type-contours. The contour of our standard of comparison (seventeenth-century English) is now represented by a vertical straight line, and all the others by appropriate curves. It is obvious that if a skull differ from the standard in some simple way, as, for instance, by greater or less breadth, uniformly distributed, its curve will approximate to the form of a straight line parallel to the vertical; if the tendency to broaden or to narrow increase from below upwards, then the curve will be more or less of a straight line set at an angle to the vertical; while if the changes are more complicated or irregular, then the new curve will be more or less sinuous. Indeed, the sinuosity of the curve will be a rough measure of the fundamental differences in form between it and the standard of comparison.

As my object here is to illustrate a method rather than the results derived from it, I will deal very briefly with the curves shown in the following figures.

In Fig. 2 the sinuosity of the Cro-magnon curve (1) indicates striking differences from the standard in the essential form of its contour; it is much narrower below, in the auricular region, then gets broader, and, finally, it is sharply constricted near the apex. The Guanche skull (2) is nearest to the Englishman's, but is narrower above. The Negro (Fernando Vas) (3) is everywhere narrower, and its curvature has a trend similar to that of the Guanche. The Eskimo (4), broad below, narrows to a great degree in the apical region.

In Fig. 3 we compare with the seventeenth-century Englishman (6) the living Englishman (Royal Engineers) and (5) the Egyptian. The latter, by its somewhat greater sinuosity, shows a greater difference than the former, it being narrow in the lower half of the section and broader or more flattened above; but the differences are obviously not nearly so great as, for instance, those between the English skull and the Eskimo or the Cro-magnon. At the same time, the differences between the Egyptian and the

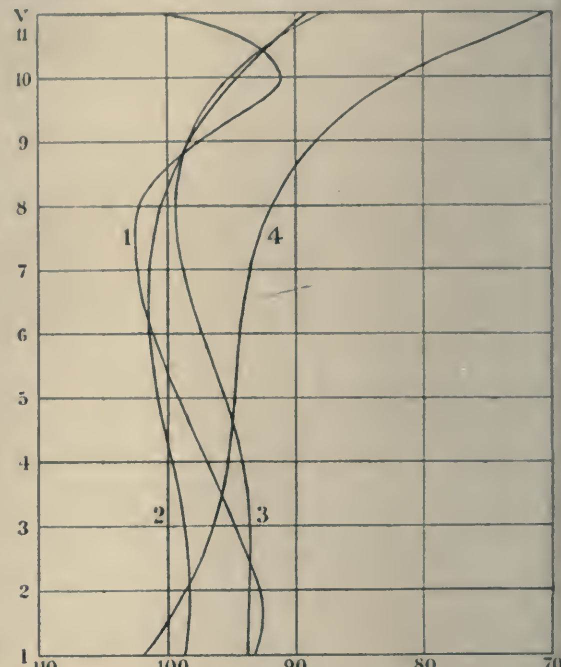


FIG. 2.

English skulls are opposite in character to all those illustrated in the former figure.

In the next figure (4) we compare (1) the transverse contour of the living Englishman with the Englishman of the seventeenth century, and (2) two Congo tribes one with another. (The curves in this instance have been slightly smoothed.) Save for a slight accentuation of apparent differences in the immediate neighbourhood of the apex

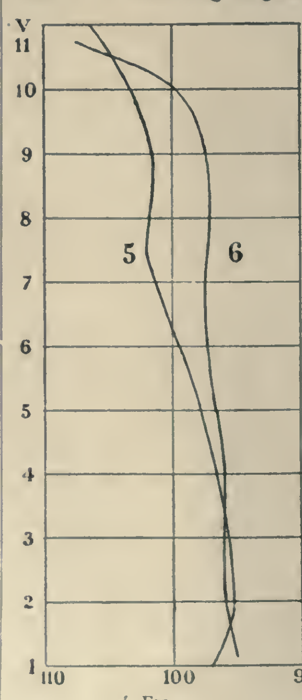


FIG. 3.

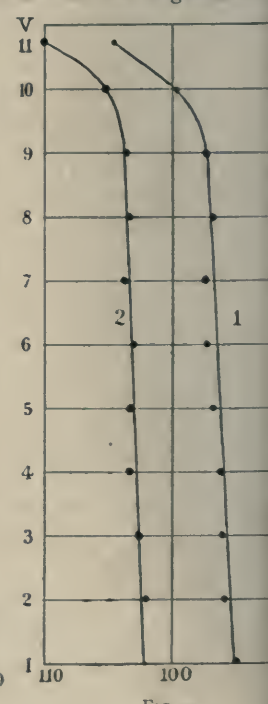


FIG. 4.

the curves are in each case all but straight, and are nearly parallel to the vertical. They show (1) that the skull of the living Englishman, that is to say, of the Royal Engineers, is a little narrower than that of the seventeenth-century Londoner, the difference being greatest across the ears, and that, in like manner, the skull of the Batetelu Negro is a little broader than that of the Negro from Fernando Vas. In both cases the general similarity, or identity of type, between the two skulls under comparison is clearly brought out.

Lastly, we may use the method to compare the left side of the skull with the right. And so we find (Fig. 5) that

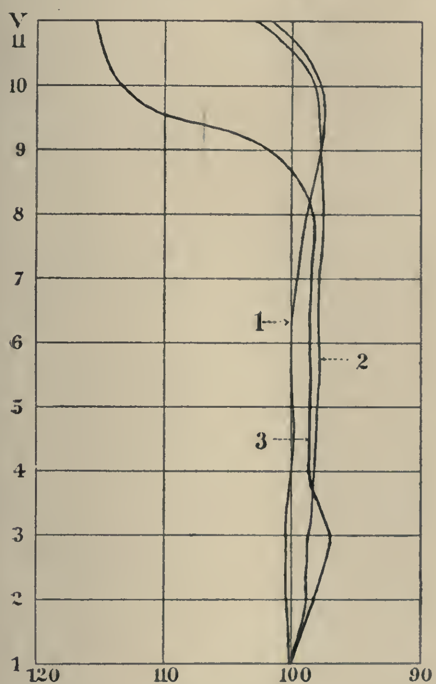


FIG. 5.

in the English skull there is approximate identity throughout most of the section, the left side being narrower in the upper portion only; in the Negro (Fernando Vas) the left side is throughout inferior, while the Cro-magnon skull is markedly unsymmetrical, the left side being the narrower below, but expanded or flattened above in a striking degree.

January 27. D'ARCY W. THOMPSON.

Microscope Stands.

THE correspondence which has ensued on the interesting article on the above subject which appeared in NATURE of December 21, 1911, has afforded much material for reflection. There must be a best possible design for a microscope stand, but it is evident that the one required by the expert amateur is different from that which is acceptable and advantageous to the professional in the laboratory. The former demands, and can with advantage utilise, many refinements that never appeal to the latter. The best English microscopes undoubtedly supply the needs of the expert—that appears to be admitted—and assuming that the design of the Continental instrument is preferred in the laboratory, it might be that the worker would derive fuller benefit from his microscope if only some additional conveniences were at his disposal and he knew how to use them.

So far, the correspondence has been contributed by experienced technical microscopists; but the views of the other side would be welcome and informing.

To revert to the article in question, no one who has had the use of a centring substage would be disposed to accept a centring adjustment to the nosepiece in preference. It is stated that the latter adjustment is provided in the Continental models, but I am unable to find a centring nosepiece listed or described in either of the catalogues of the two leading German manufacturers of microscopes, excepting only in connection with petrological microscopes. Some centring device is admitted to be necessary, and continual working with condensers having large aplanatic cones soon reveals the necessity for the centring substage.

It is suggested that the correction collar fitted to objectives is superior to the rackwork draw-tube for adjusting for varying thicknesses of cover glasses. This is quite correct; but probably not more than 1 per cent. of the objectives that are sold have correction collars, and in consequence of the perfection in which even students' lenses are now made, the sensitiveness to thickness of cover glass necessitates careful adjustment by variation of tube length. There is another important feature of the mechanical draw-tube, and that is it gives a maximum and a minimum body length which permits of the use of any objective, whether corrected for the short or the long tube, though this is subsidiary.

As to the standardisation of the substage fittings, a definite size is given by the Royal Microscopical Society, and if this is adhered to there can be very little trouble about interchanging. It has to be remembered that one-thousandth of an inch in the diameter of a tube makes all the difference between a tight and a slack fitting; tube fittings are particularly liable to variation in consequence of slight bending. Objectives do not always interchange, though all are ostensibly made to the standard size; but the alterations needed are exceedingly slight, and the differences in the substage apparatus of standard size are rarely such as cannot be quickly corrected. It seems reasonable to assume that if it be good to have a standard size for eyepieces and objectives, it is equally advantageous to have one for the substage. The English makers work loyally to the one standard of the Royal Microscopical Society, while the Continental makers each have two or three different ones.

At the bottom of all questions relating to the use of the microscope is the urgent necessity for systematic teaching in the elementary technique of the instrument. It is not unusual to meet men of eminence who are constantly working with microscopes who do not even know that a substage condenser requires to be focussed. How is it possible that the refinements of the English microscope can appeal to their students? F.R.M.S.

The Inheritance of Mental Characters.

To the discussion on the question of the inheritance of mental characters (v. NATURE, December 28, 1911, p. 278) as one who takes an interest in the subject, but can lay no claim to having expressly studied it, I should be glad to be allowed to contribute a few experiences.

In a girls' primary school the writer knew a child who from the age of five until eleven (when her education was complete) was, owing to her daring athletic feats, a torture to her teachers. They were in a perpetual worry lest she should break her bones or her neck. Punishment—and it was pretty liberal—was of no use; when their backs were turned she was at it again. They—and some of them were old teachers—had never met one like her. The other children, about 150 in number, were normal. This one had no peculiar environment, no special opportunities. But her father was a professional showman. She, like the Greek Œdipus, had never seen him, nor did her mother ever speak of him. He had been "raised" on a small farm. His brothers were commonplace workmen. The teachers were unaware of the showman parentage. Some few of us knew, and watched with interest the developments.

This case seems an instance of the inheritance of an acquired taste.

True it, no more than any case that can be brought forward, is not beyond question; for just possibly in the child—as very likely previously in the father—the mere abnormal potentiality was there. This perhaps some accident revealed to her. We always like to do what we

can do better than others, let it be tragedy writing or standing on our heads. In children this love of admiration or notoriety, instead of being judiciously cloaked, is ingenuously explicitly manifested. So, not impossibly, once discovered, this initial potentiality might have been developed.

In the elementary school in which the writer himself graduated, after every show or circus we always tried, as boys will, to emulate the somersaulting, walking on the hands, and the various bodily contortions which won our admiration in our favourite demi-god. Far and away the most successful of us—we numbered eighty or ninety—were invariably a barber's three sons. This barber, though he was then for a score of years hard and fast at his trade, had been in early life for many years a circus rider. We were all then very young, between seven and twelve. We and they were then unaware of this circumstance. Even if aware of it they could not have been in any way impelled by it except as an instinct.

This case is adduced as supporting the former instance and its deduction. In picking up facts out of books—the sole idea of education in our neighbourhood—the barber's boys were not quite so good as the average of us, but to double somersaulting they took like ducks to water.

As correlative to the saying that it takes three generations to make a gentleman, you will find among tradesfolk the statement that it requires an equal number of generations to turn out a first-rate craftsman. I met this opinion first in a pottery district. I came across it since among people of the same class in three countries, and in many distinct districts of one of them. Now if this opinion be sustainable—and personally I think so—then increasing potentiality from generation to generation, or, what it amounts to, the inheritance of acquired powers, is a fairly legitimate inference.

The transmission of like fundamental potentiality, indeed, should scarcely be questioned. The transmission of acquired potentialities, or of capacities enlarged and increased by use, is a further matter; but countless instances such as those given above could, I am convinced, be adduced in support of it. It would be hard to resist their accumulated force. It is anyway *a priori* what is to be expected, and the principle is so important that on its truth depends the perfectibility, at least, of man. To explain the transmission of this fresh inheritance remains, I think, the sole problem for men of science. Its solution, so far as I have observed, is hardly yet within sight.

The Stauhaun, Drogheda. J. M.

The Mnemic Theory of Heredity.

FIFTEEN years ago NATURE allowed me to direct attention to certain variations in the arrangement of hair on the animal body, and this was followed by several other communications elsewhere on the same subject. The conclusion from these observed facts, which were very numerous, though intrinsically unimportant, was that only by the doctrine that acquired characters can be transmitted were they to be explained. No biologist has ever challenged this conclusion, except by criticising some detail in the observations, or by saying, in effect, "Let us change the subject!" But this large body of small facts remains on record, and the smaller the individual facts are shown to be the stronger is the evidence that they are removed from the province of Selection.

If it were not for the statement, made on the high authority of Prof. Dendy, as to the "rapidly accumulating evidence" in favour of the doctrine that acquired characters can be transmitted, I would not have ventured to bring up this vexed question. But the evidence of these facts is entirely in agreement with the mnemic theory of heredity, as it seems to me; and in view of the attitude of Dr. Beard, and many other biologists, towards the doctrine of the possibility of the transmission of acquired characters, it seems necessary to bring forward facts, and more facts, however small they appear to be. After all, "things are what they are," and theories very soon after they become orthodox have a way of breaking down. WALTER KIDD.

February 12.

Distaste of Birds for Butterflies.

IN view of the recent discussions in NATURE regarding the distaste of birds for butterflies (December 21, 1911), it will doubtless be of interest to know of the results of an investigation into the relation of birds to an outbreak of butterflies (*Eugonia californica*) in northern California during the summer of 1911.

The fact that in the examination of some 40,000 stomachs by the U.S. Biological Survey there have been but few instances where birds have been found to feed on butterflies makes the results of the investigation carried on by the California Fish and Game Commission with respect to the recent outbreak of still greater interest.

During the early part of the summer the snow brush (Ceanothus sp.) was entirely defoliated by the work of the larvæ of *Eugonia californica* in many places in the mountain districts of the northern part of California. During the latter part of July and the first weeks of August the great army of caterpillars had transformed into butterflies. These insects were so numerous that the ground was often blackened by them, and great swarms of them filled the air from morning until evening.

Field observation showed the Brewer blackbird (*Euphagus cyanocephalus*) to be the most efficient destroyer of the butterflies, certain individuals being observed to eat an average of five butterflies a minute. Two other birds, the western kingbird (*Tyrannus verticalis*) and the western meadowlark (*Sturnella neglecta*), were seen to feed on the insects.

Stomach examination revealed the fact that two other birds, the blue-fronted jay (*Cyanocitta stelleri frontalis*) and the Say phœbe (*Sayornis sayus*), fed on the butterflies to some extent. Sixty-one stomachs in all were examined, representing twenty-one different species. Forty-five species of birds were noted in the locality where the investigation was carried on.

The most important fact brought out by the work was that birds will turn to food which is abundant and readily accessible, even though it be a little-relished type of food.

H. C. BRYANT.

East Hall, University of California, Berkeley, Cal., January 27.

Thomas Young and Göttingen.

THOMAS YOUNG, more particularly famous as the founder of the wave theory of light, and whom Helmholtz described as one of the most clear-seeing men who had ever lived, matriculated at Göttingen University on October 29, 1795, and took the doctor degree there in medicine on April 30, 1796.

This fact is little known, even among Young's admirers. Indeed, it had escaped the knowledge of the Göttingen authorities. With the view of perpetuating Young's memory at Göttingen, the present writer brought the matter before the notice of Dr. E. Riecke (professor of experimental physics at Göttingen University). Prof. Riecke placed the matter in the hands of the Pro-Rektor, Geh. Rat. Prof. Dr. W. Voight, who instituted inquiries as to the place of Young's abode.

It transpired that Young had lived in the building which later became the Physikalisches Institut, and is now the Institut für Angewandte Mechanik und Mathematik. It is a pleasing coincidence that in this same building Gauss and Weber did their work on the first electromagnetic telegraph.

Shortly before Christmas, as a result of Prof. Voigt's representations to the Magistrat of the town, a neat little tablet to the memory of Thomas Young was affixed. This tablet is in appropriate proximity to that in memory of Gauss and Weber.

To Prof. Voigt grateful acknowledgment is due for the enthusiastic and warm-hearted manner in which he has superintended the erection of this little memorial to one of the greatest of all physicists. H. S. ROWELL.

Glazed Frost.

REFERRING to the letters of Mr. Charles Harding and Prof. Meldola on the phenomenon of freezing rain, I remember the occasion referred to; it was on January 11, 1868, when trees were covered with ice by rain which

froze instantly on touching a solid object. In driving through Richmond Park I noticed the branches bending under a weight of clear ice, and, what was even more remarkable, the windows of my cab becoming thickened by a layer of ice while the temperature was just at the freezing point. Rain had been falling continuously until the afternoon, when the drops began to solidify on contact. From roofs and gates long icicles were formed, increasing in size; the grass was sheeted with ice, although the ground had not been chilled by frost.

It is not easy to explain the passage of very cold drops through a warm layer of air without their temperature being raised nearly to that of the layer, but, since the objects on which they fell must have been above or about the freezing point, the drops must have brought with them a degree of cold sufficient not only to cause instant solidification, but to retain the solid state some time after falling and to refrigerate the objects. The size of the drops was not unusual.

ROLLO RUSSELL.

PROF. MELDOLA in his letter (NATURE, February 1, p. 447) refers to a similar occurrence to that described by me in NATURE of January 25, and he says, "it must, I think, have been in 1866 or 1867." Prof. Meldola adds that there must be many Londoners now living who can remember the occasion.

I well remember the occurrence, and my brother, Mr. J. S. Harding, skated round Belgrave Square and the immediate neighbourhood for two or three hours.

May I give the following extract from my Meteorological Register, kept in the neighbourhood of Belgravia, which shows the time and nature of occurrence?

"1867, January 22.—Slight rain from 7.20 p.m. to 10 p.m., half congealed before it reached the ground, and forming almost simultaneously with its fall a sheet of ice upon the earth, evidently the result of rain falling from a stratum of warm air at no great distance from the earth, and not having sufficient time to be converted from rain before reaching us."

This was the close of an exceptionally severe frost; my screen temperature on January 5 was 6·5°, the lowest I have observed, and the Greenwich reading was 6·6°.

I think some meteorologists would call the phenomenon referred to by Prof. Meldola a silver thaw; it is perhaps somewhat different in character from a glazed frost, and is a sure precursor of a thaw.

CHAS. HARDING.

THE following note is to be found amongst the "Meteorological Observations" at the end of "The Natural History of Selborne" under the title of "Frozen Sleet," and appears to be an example, and a remarkable one, of the phenomenon of "glazed frost":—

"January 20.—Mr. H.'s man says that he caught this day in a lane near Hackwood Park many rooks, which, attempting to fly, fell from the trees with their wings frozen together by the sleet, that froze as it fell. There were, he affirms, many dozen so disabled.—White."

ANDREW WATT.

Scottish Meteorological Society, Edinburgh,
February 10.

ON Monday, February 5, I was in Bruges; about 8.15 p.m. I heard what I thought was hail beating upon the window panes. On leaving the house about fifteen minutes later I found that everything was covered with a film of ice at least a quarter of an inch thick. The phenomenon of "glazed frost" was very well marked, particularly upon the iron railings which run along the side of the canals, and upon the twigs of the trees. The stone cobbles with which the streets are paved were completely covered with smooth ice, and the roads were almost impassable; I saw five people fall down in as many minutes.

FRANCIS G. BELTON.

336 Belgrave Road, Birmingham.

THE letters of Mr. Harding (NATURE, p. 414) and Prof. Meldola (NATURE, p. 447) recall the following:—

On February 5, about 7.30 p.m., a heavy shower of rain, which lasted for fifteen minutes or so, suddenly fell. Being caught in this shower, naturally I hurried, but quickly found myself slipping rather than walking along, since as soon as the raindrops came in contact with the earth they apparently froze, the roadway quickly becoming covered with a coating of ice, which had a very glazed appearance. A stick which I had in my hand also became coated, and was quite "glassy" to the touch.

Although the shower was of so short a duration, the younger element of the people about at the time enjoyed themselves sliding along the Promenade and down the main street (which has a fair slope).

The temperature during the day was about 32° F., but at the time of the shower it was about 33° F.

E. WYNDHAM JEFFREYS.

University College of Wales, Aberystwyth,
February 10.

Human Eyes Shining.

WITH reference to the last paragraph in the letter by Colonel J. Herschel in NATURE of January 18, I have sometimes seen human eyes reflecting light in the way described, though, as indicated in the letters to NATURE, it is difficult to get in the right position for seeing such an occurrence. I have never tried a dark lantern. The best instance I have seen was in 1876, when I observed the light from an oil lamp inside a little girl's eyes. It was best seen when my head was between the lamp and her, and when the shadow of my head nearly came upon her eye. It appeared to be her retina that was illuminated; it was a bright orange-red, but varied in the amount of red. When my eye was nearly in the same direction as the lamp, the whole pupil was equally illuminated, but when less nearly in the same direction the side of the pupil next my shadow was the brightest, or the only part illuminated. The illumination was stronger when she looked to one side of the lamp than when she looked at it. Her sister exhibited the phenomenon less strongly, though still brightly, but her father very slightly. In the external appearance of these eyes there was nothing unusual.

I have tried to see this phenomenon in my own eyes in a looking-glass, with the sun as illuminator, but could only see a very faint illumination, very different from the above-instanced cases.

I have never used an ophthalmoscope, but I understand that when an eye is so observed the light is red or orange.

T. W. BACKHOUSE.

West Hendon House, Sunderland, February 10.

Chalk and Ice.

I HAVE read with much interest the letter on "Chalk and Ice" in NATURE of February 8, as I had observed the same phenomenon on January 7 of last year.

There had been heavy rain all the previous day and a sharp frost at night, when, in walking over Ballard Down from Swanage to Studland, in the early morning, I noticed lumps of chalk with fibrous masses of ice adhering, the ice in some cases being larger than the chalk fragment.

The soil consisted of sandy clay resting on the dip slope of the chalk, and fragments of the latter were very numerous, each with its adherent ice, which, on account of its prismatic structure, sparkled in the sunlight with bright flashes of colour, the effect being very beautiful.

The formation of ice below the surface, as suggested, is interesting, as it would certainly be an important factor in the gravitation of soil on a chalk slope during cold periods.

R. W. POCOCK.

28 Blomfield Road, W., February 9.

Candlemas Day.

IN addition to the proverbs about the weather on the second of February quoted among the Notes in last week's NATURE, allow me to give the following, which was told to me by the late Dr. Corrie, Master of Jesus College, Cambridge:—

"Si sol splendescat Maria purificante,
Majus erit frigus post festam quam fuit ante."

O. FISHER.

NATURE STUDIED IN THE FORESTS OF GUIANA.[1]

MR. RODWAY is known as the author of works on history dealing with that part of the New World where he has for some years resided. Whilst he was working up historical facts, he was at the same time making occasional excursions for the purpose of studying the forest and its inhabitants. The result is contained in this charming and readable book, first published in 1894, and now as a new edition with four new chapters and some new illustrations.

The fisherman.—From "In the Guiana Forest."

The first chapter gives a general review of the forest; then comes a pleasing description of the most important inhabitant, the gentle Arawak Indian; a new chapter in this edition devotes special attention to the Indian as a hunter, and another to him as a fisherman. Then follows an outline sketch of the animals, with a new chapter on the insects. The next chapter, on interdependence of plants and animals, serves to introduce plant-life, and the last half of the book is given up mainly to considering the struggle for life among plants.

While this book is quite different in plan from Waterton's delightfully sentimental account of his "Wanderings" in the same region, and from Im Thurn's "Among the Indians of Guiana," it appeals, like the former, rather to the general reader than to the student.

The account of the Indian from his birth to manhood is well told. His explanation of "beenas" (*i.e.* charms) seems more satisfactory than that of Im Thurn. The latter writer considers only the pain suffered in using the charm, and suggests that the custom was adopted with the idea of preparing to meet without flinching any pain or danger that may arise during the chase. That is no doubt the effect, and it confirms the Indian in the use of charms, but it is no explanation of the selection of beenas. Rodway points out that the leaves of Caladiums which are in use as charms are of various shapes and are mottled or spotted with red and other colours; "to the Indian these shapes and markings mean something; they indicate the special use of the plant. It is the old doctrine of 'signatures' so well known to the European herbalist, who once considered lungwort to be a remedy for diseases of the lungs, because its leaves were spotted like that organ." There is a special beena for every game beast, bird, and large fish. "That for the deer is one of the arrow-shaped Caladiums with ruddy veins, and a colour somewhat resembling the animal. In this case the leaf with its pointed lobes represents the facial outline and ears, while the colour is another part of the signature." The tubers of these plants contain an acrid juice which the Indian rubs into gashes made in his flesh with razor-grass. The stinging pain caused by the juice and borne without flinching signifies that the charm is powerful and is working, thereby ensuring success in the hunt.

It is a pity that the chapter on the "senses of plants" was not omitted in this edition. The author appears to think that plants have three out of five senses, that they suffer pain (p. 292), and that they can be credited with the foresight to strive for a particular object (p. 283). The word feeling is used loosely to express touch, and also a consciousness of touch. When the roots of a plant absorb different quantities of various materials, they are said to exercise the senses of taste and smell, and to distinguish suitable from unsuitable food! Schopenhauer somewhere remarks that consciousness sleeps in the stone, dreams in the plant, and wakes up in the animal. Mr. Rodway seems to go very much further, and to put plants in the same class as animals. But in plants there are no differentiated organs, nor nervous system. When a root bends, the cells at the tip where the stimulus is received do not differ, except in being younger, from those higher up along which the stimulus passes, nor from those where the response is made and the bending takes place. It is scarcely scientific to apply to plants terms which are properly restricted to man and the higher animals.

[1] "In the Guiana Forest." Studies of Nature in Relation to the Struggle for Life. By J. Rodway. New, revised and enlarged edition. Pp. 326. (London: T. Fisher Unwin, n.d.) Price 7*s*. 6*d*. net.

The last two chapters are on the causes of the struggle and nature's laws; they are somewhat discursive, and are not very helpful towards a better understanding of the subject.

The illustrations are from photographs and are well done; one of a fisherman is reproduced here.

ATMOSPHERIC CIRCULATION OVER THE TROPICAL ATLANTIC.[1]

THE general circulation of the atmosphere provides meteorology with one of its most fascinating problems, because the details must ultimately be known by observation, while the theoretical results hitherto obtained cannot, with reasonable values for friction, be made to agree quantitatively with the observed motions. In the region of the trade-winds, the average conditions persist with sufficient regularity to make them the necessary basis of any wind-chart and a fundamental criterion as to the general truth of the conclusions deduced hydrodynamically on the assumption of a known distribution of temperature. It was for a long time confidently believed that above the trade-winds themselves, at no very great heights, there prevailed a counter-current, as steady and regular in its main features as the wind beneath it. Every schematic representation of the circulation by Maury, Ferrel, James Thomson, though differing in other features, agreed in this one, and the conclusions drawn by Hildebrandsson from the observations of clouds supported them.

It was therefore a surprise when Prof. Hergesell reported in 1904 that observations made over the Atlantic on the Prince of Monaco's yacht, *Princess Alice*, had revealed the existence of an apparently persistent and extensive N.W. wind above the N.E. trades. The conclusion was based on observations made during the course of one summer only, but the different observations were sufficiently concordant to give Hergesell confidence in the conclusion. Clearly such a N.W. wind could not prevail around the whole tropical belt because the flow of air southward in the trades must be balanced by a corresponding flow northwards. It is, moreover, impossible to devise a scheme of pressure distribution which would satisfy the elementary principles of atmospheric motion, and permit of N.W. winds at all points on a parallel of latitude. The view was therefore received with some scepticism, and in order to obtain further, and, if possible, conclusive evidence on the point, M. L. Teisserenc de Bort and Prof. Rotch organised a more systematic investigation of the conditions over the Atlantic, and the results of the observations made on voyages in 1905, 1906, 1907, are published in the present volume. In 1905, 1907 the observations were made solely in the N.E. trades in the summer months, July, August, and in 1907 in September also. In 1906 two separate expeditions were made, the first in February in the N.E. trades, the second from May to the middle of August, in the region between the Azores, 38° N., and Ascension, 8° S. The actual observations were made by Prof. H. H. Clayton and M. H. Maurice and other assistants.

The first quarter of the book is devoted to description and discussion. In an introductory chapter of fourteen pages, the authors refer briefly to the reasons which induced them to undertake the work, summarise the results obtained, and add some notes on the boat, the *Otaria*, a "fish carrier," and on the methods employed. They express their thanks to the Admiralty, who, at the request of Dr. Shaw, readily undertook to supply coal to the *Otaria* at Ascension, where there are no private supplies, but it is rather humiliating to reflect that this represents the total contribution of England to these recent investigations over the Atlantic.

M. H. Maurice, assistant at the Trappes Observatory, who accompanied the expedition, contributes a long article of thirty-six pages, giving the history of the investigations and details of the methods used. The article is illustrated by many photographs taken on the voyages. Some of these are useful in helping the reader to understand the procedure adopted for making ascents, and others, such as the photographs of clouds, form a contribution to meteorological art, but it is difficult to see the special meteorological significance of a photograph of a "Group of Women and Children" at the Cape Verde Islands.

A short notice of seven pages by Prof. H. H. Clayton deals with the meteorological conditions in the region of the trade-winds up to heights of 2000 metres. It is based upon results obtained during the voyages of 1905, 1906, and is accompanied by a series of diagrams showing the distribution of humidity and temperature at different heights and latitudes. One of the most interesting features is the relatively warm and dry body of air at an altitude of about 1000 metres, which was found in every month between latitudes 15° and 30° N. The paper is an example of concise discussion, and it is to be regretted that it does not embrace the whole of the observations for all heights reached.

The remaining three-fourths of the book contain the results of the individual ascents, together with plates illustrating the routes followed in the different expeditions, and showing the character of the observed motion at different places for heights up to 20 kilometres. These results are proving of the greatest value, not only for dealing with the problems which the authors set out to solve, but in connection with such questions as the motion in the stratosphere in the equatorial regions and the gradient of pressure at high levels.

The general conclusion drawn from the observations is that the N.E. trade-winds form a layer the mean height of which is only 1000 metres; above this comes a region where the wind has still a northerly component, and usually blows from N.W. These N.W. winds are, however, not found further south than lat. 20° in summer, which is about 12° north of the region between the two systems of trade-winds. Above the region of N.W. winds, anti-trades prevail, beginning at a height of about 3000 metres near the Canaries, lat. 30° N., and at 1800 metres, near Cape Verde Islands, lat. 15° N. They blow from S.E. near the equator, changing gradually through S. to S.W., near the northern limit of the trade-winds, and finally passing over into westerly winds in the latitude of the Azores. The N.W. winds discovered by Hergesell appear to be a prolongation over the trade-wind region of a current from higher latitudes, similar to that indicated by James Thomson, and attributed by him to "a revolutional momentum brought from equatorial regions and not yet exhausted." The inter-tropical circulation is therefore in its main features in agreement with the views held by the majority of meteorologists before any actual investigations by means of kites and balloons had been undertaken. It is extremely gratifying that the authors have been enabled by this prolonged series of observations to reach definite conclusions where previously nothing but plausible hypotheses existed. It is earnestly hoped that the investigations will not end here, but that a united effort will be made to obtain observations

[1] "Travaux Scientifiques de l'Observatoire de Météorologie Dynamique de Trappes, avec la collaboration de l'Observatoire de Blue Hill." "Travaux de l'Atmosphère Marine par Sondages Aériens Atlantique Moyen et Région Intertropicale." By MM. L. Teisserenc de Bort et A. L. Rotch. Pp. 243+xvii plates. (Paris: Gauthier Villars, 1909.)

simultaneously along a parallel of latitude, and, if possible, to combine these with regular series of ascents at places distributed as nearly as possible along a meridian. When this has been done a firm foundation for a survey of the atmosphere will have been laid.

There is a certain lack of coherence about the present work, so that although each individual contribution is excellent, the collection does not reach the same standard. Something of this kind is perhaps inevitable where different authors, separated from each other by the Atlantic, undertake to write different sections of a scientific report which are closely related to each other, and require to be published without undue delay.

E. GOLD.

PRECISION OF LEVELLING OPERATIONS.[1]

THE volume referred to below, containing the account and discussion of the precise levelling operations in India from 1858 to 1909, is published at an opportune time. The revision of the main lines of levels in this country and the establishment of really permanent bench marks is, we understand, a task that our Ordnance Survey intends to take up at an early date. The experience gained in the Indian work as recorded in this volume cannot fail to be of great value.

As with any other physical measurement, we find in the case of levelling that increased precision means that problems unimportant or often unthought of in earlier days rise to prominence and demand solution. Thus at the very outset of the subject we are confronted by a question of definition; what do we mean when we say that two points are at the same level? Do we mean that the distance of each point from the surface which would correspond with the mean sea surface, assuming the land to be removed, measured along the normal is identical, or do we mean that our two points lie on the same equipotential surface? The former definition gives us the so-called "orthometric" height, while the latter gives what has, perhaps not very happily, been called the "dynamic" height.

Thus consider the case of a lake. The dynamic height of every point on the water surface is evidently the same, but the actual vertical distance above sea-level varies from point to point, the rate of variation being a maximum along a north and south line and zero, if we exclude second-order distortions of the spheroid, along an east and west line.

Authorities vary as to which system is on the whole the more convenient for practical use, so that the Indian Survey has followed the safe plan of printing both values. We may, however, venture the remark that a convention which assigns different "levels" to different points upon the surface of still water is repugnant to a very large class of practical men, namely, the engineers. The difference between the heights of a station, measured on the two systems, amounts to a maximum of nearly two feet in the case of Bangalore, 3000 feet above the sea, a figure which would obviously be largely exceeded if the levelling were extended to regions of great elevation, and if the mean latitude were differently selected. It is not quite clear in choosing a mean latitude of 24° for the zero of their dynamic heights, and thereby making the system valid only for India, that the Survey experts have adopted the best course. It is an arguable question, which we merely mention here without, be it understood, expressing any definite opinion, whether, if dynamic heights are to be used at all, they should not be based upon a universal datum, and therefore referred to a mean latitude of 45°.

The discussion of the level errors is of great interest and importance. The conclusion arrived at is that for the Indian work the error of a circuit varies neither directly as the length nor as the square root of the length, but in accordance with an intermediate formula:—

$$\text{Error in feet} = \sqrt{(0\cdot004)^2 M + (0\cdot00034)^2 M^2},$$

where M is the distance in miles.

This gives one-tenth of a foot for a line of 235 miles, and one foot for about 2800 miles, a very satisfactory degree of precision.

The importance of both accurate and permanent bench marks is rightly insisted upon. Many cases have been found where the marks have moved, and obviously no deductions can be drawn as to elevations or subsidences in the earth's crust unless the stability of the bench marks is beyond suspicion.

E. H. H.

[1] "Account of the Operations of the Great Trigonometrical Survey of India." Vol. xix., Levelling of Precision in India (1858–1909). By Colonel S. G. Burrard, R.E., F.R.S. Pp. xiii+484+xviii plates. (Dehra-Dun: Office of the Trigonometrical Survey of India, 1910.) Price 10.8 rupees.

DR. HENRY TAYLOR BOVEY, F.R.S.

WE announced with regret last week the death of Dr. H. T. Bovey, late rector of the Imperial College of Science and Technology, and formerly dean of the faculty of applied science in McGill University, Montreal, which occurred at his residence in Eastbourne on February 2. The funeral service was held at St. John's Church, Eastbourne, on February 6, and his remains were interred in Eastbourne Cemetery.

Dr. Bovey was born at Torquay in 1852, and after being educated in a local school, entered Queens' College, Cambridge, in 1870. He graduated in 1873 as twelfth wrangler, and was elected a fellow of his college in 1876. He entered the profession of engineering, and joined the staff of the Mersey Docks and Harbour Board. Whilst at Liverpool he took part in founding the Liverpool Society of Civil Engineers, and he had every reason to look forward to a prosperous professional life in England. But an accident occurred which gave his life a new bent, and afforded opportunity for a brilliant career elsewhere. Like the best type of Cambridge honours man, Dr. Bovey was a keen supporter of athletics. Whilst taking part in a game of football, he was thrown down and had several ribs broken. He made a good recovery, but one lung had been slightly injured, and he was advised to spend the next winter in a dry climate, lest the wound should become a focus for pulmonary disease. He therefore accepted from Sir William Dawson, principal of McGill University, the offer of a chair in civil engineering and applied mechanics, but declined to bind himself to hold this post for longer than a year.

When Dr. Bovey arrived in Montreal in 1881, he found that his post was indeed a sinecure. Not only was there no laboratory of any description, but his chair was attached to the "Arts" faculty, and his subject had to compete with literary subjects as an option for a degree. At that time in McGill the principal qualification for the success of an optional subject was constituted by its claims to be considered a "soft snap," *i.e.* by demanding light work and having easy terminal examinations. The mathematical teaching provided by the University was quite unsuited to engineering students, and Dr. Bovey's efforts to have it modified met with no success. Next year, therefore, Dr. Bovey resigned his chair, and was about to return to England, but he was pressed by

the principal to draw up a scheme for the better instruction of engineering students. This he did, and the scheme provided for the establishment of a separate faculty of applied science, with its own chair of mathematics. The principal then said that if Dr. Bovey would remain his scheme would be carried into effect as soon as funds permitted. Dr. Bovey agreed to remain, and by constant and heroic struggles during the next twenty-five years, he gradually built up one of the finest engineering schools in the world.

Money came in at first very slowly, and only Dr. Bovey's marvellous tact and the respect and affection which he everywhere inspired enabled him to make any headway with his scheme. At last he succeeded in interesting Mr. (now Sir William) Macdonald, a rich and respected Montreal merchant, in his plans. This gentleman travelled with Dr. Bovey over the United States in order to inspect the fine engineering schools of that country. Dr. Bovey stimulated his friend's Canadian patriotism by pointing out how far behind Canada was in this matter. On their return to Canada Sir William Macdonald announced his intention of building and endowing the finest engineering school on the continent. This was Sir William Macdonald's first important donation to McGill; it was followed by so many others that he can justly be regarded as the second founder of the University. At Dr. Bovey's suggestion, Sir William built and equipped the splendid physical laboratory, and founded the chair in physics, the two first occupants of which have been Profs. Callendar and Rutherford. Dr. Bovey adhered with unflinching firmness, in spite of the grumbling of his more "practical" colleagues, to the necessity of a thorough mathematical training for engineering students; and as the excellence of McGill engineering graduates became known, they were so much sought after that Dr. Bovey used to have on his desk more offers of positions for his graduates than his entire graduating class could occupy.

As his success became evident, honours flowed in on him. He was given honorary degrees, was elected fellow of the Royal Society, honorary fellow of his college at Cambridge, and he was finally, in 1908, selected as first rector of the Imperial College of Science and Technology. At that time the faculty of applied science in McGill comprised more than 600 students, and was attracting men from all over America, and even from England. Alas! unknown to Dr. Bovey himself, the fatal disease which was to cut short his career had already fastened on him, and his short tenure of the rectorship of the Imperial College was a struggle against increasing ill-health until his resignation in 1909. Nevertheless he did the College invaluable service. Though a mathematician and engineer, his sympathies were not confined to those subjects; he took the broadest view of the possible services of the College to science, and gave cordial and effective support to the reorganisation and re-equipment of the biological departments of the College.

Dr. Bovey married in 1882 Miss Emily Redpath, a lady equally popular with himself, and a member of a leading Montreal family. He is survived by his widow, two sons, and three daughters. The elder son is pursuing a brilliant career at the Montreal Bar; the younger is a King's scholar at Westminster. No words could do justice to the attractiveness of Dr. Bovey's character. His sympathy, wise counsel, and practical helpfulness will long live in the memory of his friends, amongst whom were all the junior members of his staff in McGill, and especially those new to Canadian life. To those who, like the writer, were privileged to enjoy his intimate friendship, his death is an irreparable loss.

E. W. M.

SIR WILLIAM ALLCHIN.

SIR WILLIAM ALLCHIN died in a nursing home in London on February 8, in his sixty-sixth year, some days after an operation and after several months of illness. The son of a doctor in Bayswater, he was, like his father, educated medically at University College Hospital. After being medical officer to the s.s. *Great Eastern,* which was employed in laying the submarine cable, he became assistant physician, and subsequently dean of the medical school at the Westminster hospital, with which he remained connected in the capacities of physician, consulting physician, and vice-president until his death. He was also consulting physician to the Victoria Hospital for Children, the Western Dispensary, and the St. Marylebone General Dispensary. He played a very active part in medicine in London, holding numerous offices and lectureships at the Royal College of Physicians, and at the Medical Society of London, of which he was president in 1901–2. He contributed articles mainly on abdominal diseases to standard works on medicine, such as Allbutt's "System of Medicine," Quain's Dictionary and the "Encyclopædia Medica," and edited, for Messrs. Macmillan, "A Manual of Medicine," in five volumes, the last of which appeared in 1903. His distinction as a physician was shown by his appointment as Physician Extraordinary to H.M. the King.

Sir William Allchin devoted much time and trouble to the University of London, and had an exhaustive knowledge of the tangled problems which have exercised medical educationists during the last twenty-five years. He was the representative of the Royal College of Physicians on the Senate of the University of London from 1902 to 1910, and probably his last appearance in public was as a witness before the Royal Commission on University Education in London in July, 1911, when he gave expression to his own views based on forty-five years' experience, during which he had been actively concerned in medical education and examinations.

At various times he examined at the Universities of London, Durham, and Glasgow, at the Conjoint Board of the Royal Colleges of Physicians and Surgeons, for the Naval, the Army, and the Indian Medical Services, and was also a member of the Advisory Medical Board of the Admiralty. He had a considerable knowledge of old medical books, and did much in arranging the library of the Medical Society of London, of which he was honorary librarian for eighteen years. He was also a high authority on precedence. He was not an original thinker or investigator, but his judicial mind, high standards, and conscientious devotion to the somewhat tedious work of committees have been of great value to the cause of medical education.

H. D. R.

NOTES.

WE notice with the deepest regret the announcement of the death of Lord Lister, on February 10, in his eighty-fifth year. An account of his work appeared in our series of "Scientific Worthies" on May 7, 1896, and we hope to supplement this next week with a further appreciative statement of his services to science and humanity. The King has sent a message of sympathy to Lord Lister's family. Queen Alexandra and other members of the Royal Family have sent telegrams also, Queen Alexandra's message being in the following terms:—"Pray accept my most sincere sympathy in the great loss which the whole nation shares at the death of Lord Lister, whose name will ever be honoured and gratefully remembered as that of

the greatest benefactor to suffering humanity throughout the world." Sir Ray Lankester has received the following telegram from the directors of the Institut Pasteur, Paris:—"L'Institut Pasteur vous prie d'exprimer à la famille de l'illustre Lister et à la Société Royale les regrets que lui cause la mort du rénovateur de la chirurgie.—Roux, Metchnikoff." We learn from *The Times* that the Dean of Westminster offered that the remains of Lord Lister should be interred in the Abbey, subject to the condition of cremation. The Royal Society and the Royal College of Surgeons also made representations to the Dean in the hope that this offer would be made. It appears, however, that Lord Lister expressed the desire that he should be buried in the Hampstead Churchyard, where his wife lies. The first part of the funeral service will be held in Westminster Abbey on Friday, beginning at 1.30 p.m. The Dean, accompanied by the Abbey clergy, will conduct the service. This evening the coffin will be taken from Lord Lister's London residence in Park Crescent into the Abbey, and placed in St. Faith's Chapel. There it will remain until to-morrow morning, when it will be removed to a spot facing the altar. Only members of the family will be present at the interment in Hampstead Churchyard.

We regret to see the announcement of the death, on February 12, at ninety-three years of age, of the Rev. Francis Bashforth, distinguished by his experiments in ballistics, and for some time professor of applied mathematics to the advanced class of Royal Artillery officers at Woolwich. *The Times* of February 14 gives the following account of his work:—Between the years 1864 and 1880 Mr. Bashforth carried out a series of experiments which really formed the foundation of our knowledge of the resistance of the air, as employed in the construction of ballistic tables. He published, notably, "A Report on the Experiments made with the Bashforth Chronograph, &c., 1865–1870," and another report dated 1878–1880, as well as "The Bashforth Chronograph" (Cambridge, 1890). These experiments were calculated to show that the resistance of the air can be represented by no simple algebraical law over a large range of velocity. Having abandoned, therefore, all *a priori* theoretical assumption, Mr. Bashforth set to work to measure experimentally the velocity of shot and the resistance of the air by means of equidistant electric screens furnished with vertical threads or wire, and by a chronograph which measured the instants of time at which the screens were cut by a shot flying nearly horizontally. Formulæ of the calculus of finite differences enabled the experimenter from the chronograph records to infer the velocity and retardation of the shot, and thence the resistance of the air. In consideration of the importance of these experiments and of his inventions, Mr. Bashforth received a Government grant of 2000*l*., and was also granted a pension.

We regret to learn of the death, on February 4, of Mr. George Edwards Comerford Casey. Born on March 19, 1846, Mr. Casey graduated at Lincoln College, Oxford, taking subsequently the degree of M.A. Although a teacher by profession, Mr. Casey spent the happiest days of his life on the sunny shores of the Mediterranean, and he will be best known to biologists as the anonymous author of "Riviera Nature Notes" (London: Bernard Quaritch), a stimulating and original book which, perhaps partly because not written on the conventional lines of a scientific treatise, imparts a living reality to the facts which it describes such as is very difficult of attainment in our modern text-books of "nature-study." The English translation of Prof. Strasburger's "Streifzüge an der Riviera" (London: T. Fisher Unwin) was prepared by Mr. Casey's two daughters.

On Saturday, February 24, Sir J. J. Thomson will begin a course of six lectures at the Royal Institution on "Molecular Physics." The Friday evening discourse on February 23 will be delivered by Mr. G. K. B. Elphinstone, on "The Gyrostatic Compass and Practical Applications on Gyrostats"; on March 1 by Dr. W. J. S. Lockyer, on "The Total Solar Eclipse in the South Pacific, April, 1911"; and on March 8 by Dr. A. W. Ward, on "The Effects of the Thirty Years' War."

The council of the Society of Engineers (Incorporated) may award in 1912 two premiums of books or instruments, to the value of 8*l*. 8*s*. and 4*l*. 4*s*., as first and second prizes, respectively, for approved essays on the subject of "How to Improve the Status of Engineers and Engineering, with Special Reference to Consulting Engineers." The competition is open to all, but application for detailed particulars should be made to the secretary before entering. The last date for receiving essays is Friday, May 31.

At the anniversary meeting of the Royal Astronomical Society, held on February 9, the following officers and council were elected:—*President*, Dr. F. W. Dyson, F.R.S.; *vice-presidents*, Mr. E. B. Knobel, Dr. W. H. Maw, Mr. S. A. Saunder, and Prof. H. H. Turner, F.R.S.; *treasurer*, Major E. H. Hills, C.M.G., F.R.S.; *secretaries*, Mr. A. S. Eddington and Mr. A. R. Hinks; *foreign secretary*, Sir David Gill, K.C.B., F.R.S.; *council*, Sir R. S. Ball, F.R.S., Sir W. H. M. Christie, K.C.B., F.R.S., Rev. A. L. Cortie, S.J., Dr. P. H. Cowell, F.R.S., Dr. A. C. D. Crommelin, Rear-Admiral H. E. Purey Cust, C.B., R.N., Prof. Alfred Fowler, F.R.S., Dr. J. W. L. Glaisher, F.R.S., Mr. J. A. Hardcastle, Prof. H. F. Newall, F.R.S., Rev. T. E. R. Phillips, and Mr. F. J. M. Stratton.

As a result of the recommendations recently made by a joint committee of the South African Association for the Advancement of Science and the Royal Society of South Africa, a general committee, we learn from the December (1911) issue of *The South African Journal of Science*, has been constituted for the purpose of considering applications received for grants. Five grants, amounting in all to 250*l*., were made at the first meeting of the committee held towards the end of last year. The grants were:—(1) 40*l*. to Prof. W. A. D. Rudge, of Grey University College, Bloemfontein, to obtain a continuous record of the variations in the atmospheric gradient at various places, and to ascertain the relation between potential gradient and altitude, and between the diurnal variation of the gradient and the variation in the atmospheric pressure; (2) 45*l*. to Prof. A. Young, of the South African College, Cape Town, to investigate the occurrence of semi-diurnal, diurnal, and spring and neap tides observed in connection with an artesian well in the Cradock district; (3) 75*l*. to Miss D. F. Bleek, to proceed to the Kalahari, so as to obtain phonographic records of the spoken language of the Bushman tribes north of the Orange and Vaal Rivers; (4) 50*l*. to Mr. R. N. Hall, to visit localities in Rhodesia, where Bushman paintings exist; (5) 40*l*. to Mr. W. T. Saxton, of the South African College, Cape Town, for the purpose of studying the fungus diseases of trees in the Transkeian forests, investigating the ecology of the typical formations of the Transkeian territory, investigating a reported occurrence of the typical Western Province flora at St. John's, and to collect material for the study of the two genera of South African cycads, Stangeria and Encephalartos.

In *Man* for February, Dr. C. G. Seligmann describes a cretinous skull found by Prof. Flinders Petrie while exploring a temple of Thotmes IV. at Thebes. He distinguishes this specimen from others of the achondroplastic type, because the arrest of the development of the nasal bones is very marked. In achondroplastic skulls, on the contrary, the nasal bones and the nasal processes of the maxillæ develop normally, though, owing to the shortness of the base, the angle made with the frontal may be abnormal. This specimen thus agrees in this particular with undoubtedly cretinous skulls, and may be regarded as that of an eighteenth-dynasty cretin.

Mr. Thomas E. Smurthwaite sends us a booklet entitled "Practical Anthropology," in which he has expanded his method of racial analysis. Mr. Smurthwaite's method is founded on a study of the contour of the head and face. In every nation or people he finds there are six types of head and face, and believes, therefore, that there were six original races. By a compounding of these original races the various nations and tribes have been evolved. We fear Mr. Smurthwaite's proposal to apply his methods to a racial analysis of school children is doomed to failure, because of the uncertainty in the recognition of the various types he seeks to differentiate.

We note that Dr. Robert B. Bean employs a series of types in his description of the natives of the Philippine Islands. In a series of papers which have recently appeared in the *Philippine Journal of Science*, *American Naturalist*, and *American Anthropologists*, he classifies all men and women into three types—Primitive, Iberian, and Australoid. These three forms he regards as the fundamental units of mankind. He recognised them amongst the Negritoes and among the various tribes to be found in Luzon and Mindoro. Dr. Bean's colleagues, however, will find his excellent and numerous photographs more helpful than his text. It is very evident that the inhabitants of the Philippine Islands represent a most interesting congeries of peoples. Besides the small negroids—some of them might pass as natives of Equatorial Africa—it is plain that there are, in addition to the dominant Malay race, peoples who recall the Japanese, the Chinese, and the Ainus. Perhaps the most interesting discovery made by Dr. Bean is a native type of man with long bushy beard and European features. It seems possible that there are elements within the native tribes of the Philippine Islands which may throw light on the origin and distribution of the various races which are found on the shores of the Pacific Ocean.

The last number of *The Bulletin of Entomological Research* (vol. ii., part iv., p. 357) contains an important memoir by Mr. R. W. Jack entitled "Observations on the Breeding Haunts of *Glossina morsitans*." A number of places in which the puparia of the fly were found are described, and illustrated by very good photographs. The puparia were always found at the bases of trees, in the soil, either sheltered by a hollow in the tree-trunk or under the exposed roots. On the other hand, negative results were obtained from careful search in the soil under bushes, although shaded, loose, full of humus, and covered with leaves; the writer is of opinion that the instinct of the parent fly is to avoid such places, where the pupæ would be in danger from the scratching of game-birds, &c. Along the Gorai River great numbers of guinea-fowl, "pheasant" (Pternistes), and francolin occurred, and there all the ground under the bushes had been scratched over and over again. The writer considers that "the tsetse-fly is such a comparatively slow breeder that it can scarcely afford to expose its pupæ to the scratchings of the game-birds." The practical bearing of these observations seems perfectly obvious: it is that fowls or other scratching birds should be encouraged or introduced in the forests or amongst the trees where the fly deposits its pupæ, especially in the vicinity of villages or homesteads, where the wild game-birds are naturally scared away.

Naturen for January, which appears in a new type of cover, contains a portrait and biography of Prof. W. C. Brøgger, the well-known geologist, and Rector of Christiania University. Its contents also include the first portion of the natural history results of the Danish oceanographic cruise of the *Thor* in the Mediterranean in the summer of 1910.

In 1909 Mr. F. F. Outes, of the La Plata Museum, published the first part of what was intended to be a monograph of the morphology of the early inhabitants of Entre Rios, dealing in that instance with certain abnormalities in connection with the cranial sutures. The plan, as we learn from a second communication by the same author, published in vol. xviii. of the *Revista del Museo de la Plata*, has now been abandoned. Mr. Outes accordingly contents himself in the paper cited with describing certain cranial variations and abnormalities observable in the remains of these people preserved in the La Plata and Buenos Aires Museums.

No. 61 of *Publications de Circonstance*, issued at Copenhagen by the Conseil Permanent International pour l'Exploration de la Mer, is devoted to a report on the investigations on herrings in the North Sea conducted during 1910, the first part, by Messrs. J. Hjort and E. Lea, dealing with the whole question, and based on observations extending from 1907 to 1911, while the second, by Mr. Lea, discusses the growth of herrings. An important part of the investigation has consisted in the "grading" of herrings, that is to say, the determination of the range of variation presented by the individuals of the same age, or, in other words, of particular year-groups. There were from the first reasons to believe that the members of a shoal belonging to the same year and spawning together might represent different growth-types, and the features presented by those of 1904 proved this to be the case. In one lot of these herrings the growth-rings on the scales were of a normal, and in another of an abnormal, type. The abnormal type occurred in all the samples of what are known as "fat herrings" from Nordland in that year, and it served to show that by the autumn of 1909 the herrings in more southern waters were largely reinforced by a migration from the north. It has also been demonstrated that the "fat herrings" are fish of from one to seven, but chiefly of from two to four, years old, and that the youngest classes of the "large" and "spring herrings" are three-year-old fish, while the majority are from four to eight years old, although the shoals may include individuals up to sixteen or eighteen years. As regards the economic importance of such determinations, it is known that a great falling-off took place in the fisheries between 1904 and 1906, and that in 1907 there were no fish older than three years, and in 1908 none exceeding four years. This means that "fat herrings" were practically absent in 1902 and 1903. Obviously, then, determinations of this nature will afford means of predicting good or bad catches in the future when sufficient data are available.

Mr. N. Hollister, assistant curator of the Division of Mammals, U.S. National Museum, announces the discovery of four new animals from the Canadian Rockies in a paper just published by the Smithsonian Institution. During last summer a small party of naturalists from the Smithsonian

Institution accompanied the expedition of the Alpine Club of Canada to the Mount Robson region, where they made the first natural history collection ever taken in that vicinity. The natural history work of the expedition was under the charge of Mr. Hollister, who paid especial attention to the mammals, four of which he describes—a chipmunk, a mantelled ground-squirrel, and two bats. All the specimens come from the neighbourhood of Mount Robson, which lies in one of the wild and unexplored parts of British Columbia, at about 14,500 feet elevation. The chipmunk is a new species, and all the specimens of it come from the region along the boundary line between British Columbia and Alberta, from Yellowhead Pass northward. The ground-squirrel is a beautifully marked and highly coloured form of the genus, and was found living in the alpine meadows and rocks of the snow-covered region above timber-line. The head and shoulders are a rich and glossy Mars brown, and the sides are marked by conspicuous lateral stripes. While the two new species of bats resemble some well-known forms, externally they are distinct and readily distinguishable by the shape of the skull. One of them most resembles a species known only from Mexico. This paper forms No. 2062 of the Smithsonian Miscellaneous Collections.

The Imperial Geological Survey of Austria has decided to reserve a whole volume of its *Abhandlungen* for a new and exhaustive description of the Miocene fossils of the Vienna basin. It is nearly half a century since Hoernes completed his well-known monograph on the fossil Mollusca of this region, and so much progress has been made during recent years in studying the fossils from corresponding deposits in other Mediterranean areas that a renewed examination of the Viennese collections has become necessary for comparative work. Dr. Franz X. Schaffer has begun the revision by a study of the bivalved shells from the Miocene of Eggenburg, and his results occupy the first part of the projected new volume, which has been recently issued. The concise descriptions are illustrated by forty-seven fine plates, towards the cost of which a large contribution has been made by the Krahuletz Society of Eggenburg. Dr. G. de Alessandri follows with a brief account of the cirripedes from the same formation, which, as might be expected, belong to genera and species of shallow-water habitat.

The biennial report of the Connecticut Agricultural Experiment Station forms a ponderous volume of nearly 900 pages, containing reports of the analyst, entomologist, botanist, and forester. The station is required by statute to analyse yearly at least one sample of every commercial fertiliser offered for sale in the State, and to publish the results, together with the name of the dealer. A paper is contributed by Mr. East on the transmission of variations in the potato in asexual reproduction. All the observed asexual variations were losses of character, no new characters coming out. Otherwise there is a close parallel with the variations produced in sexual production.

The report of the director of agriculture of the Federated Malay Straits shows that there has been a considerable change in the staff of the department, and in consequence no new work could be originated. There has been a great increase in the rubber output, which amounted in 1910 to 12,563,220 lb., as against 6,083,493 lb. for 1909; greater increases are anticipated during the next few years. Labour presents some difficulties, but on the whole the factors involved in the production of rubber are tolerably well understood. The working up of the raw rubber is still in the experimental stage. What is said to be wanted is a simple and trustworthy test for the strength of rubber as it leaves the plantation factory comparable with the polariscope test for sugar; at present rubber is judged only by colour and general appearance. Only two fungoid diseases were said to be serious, a root disease due to *Fomes semitostus*, and "die-back," due to *Thyridaria (diplodia) tarda*. *Termes gestroi* appears to be the most serious of the insect pests. Cocoa-nuts are also grown, and incidentally their husks furnish useful fuel for smoking rubber where this is carried out.

Prof. W. Pfeffer's paper on the mechanical prevention of sleep-movements in plants (*Abhandl. K. Sächs. Ges.*, 1911) is a continuation of his important work, "Investigations of the Appearance of Sleep-movements in Plants," published in the same journal in 1907—a paper in which nyctitropic movements were for the first time automatically recorded by a thoroughly good method. The most interesting result of the present paper is the discovery that the internal changes, on which sleep-movements depend, continue their normal course even when the leaves are fixed so that they cannot execute the normal movements. Thus a plant fixed in the diurnal position will assume the night position if released at the right hour, and in the same way a plant fixed in the night position wakes if freed in the morning. Similar conclusions are drawn from the study of leaves not kept absolutely still, but so as to show very minute sleep-movements.

In the *Zeitschrift der Gesellschaft für Erdkunde* for 1911 there has appeared a series of descriptions of sheets of the 1 : 100,000 map of the German Empire, in which the principal geographical characteristics of each sheet are clearly summarised. Structure, surface, and erosive action are indicated wherever they are well shown, as well as the settlements, communications, and the general development of the region whenever these have been clearly influenced by the geography. More than one hundred and fifty sheets are also classified by the geographical forms which they represent, so as to be of use for geographical instruction.

We have received a copy of the Almanac for 1912 which is compiled in the offices of the Survey Department for use in the Government offices of Egypt. Since five calendars are ordinarily in use, viz. the Mahommedan, Coptic, Jewish, Julian, and Gregorian, such a compilation is indispensable. The almanac also contains a large amount of information relating to the regulations, procedure, &c., of different Government departments, which is otherwise not always easy to obtain. It is of special interest to note that substantial brass plates have been laid down in a permanent manner at the headquarters of the administration in each province for the verification of the chains which are now generally used for land-measurement. Lengths of 20 metres and of 5 qasabas (17·75 metres) are defined by marks engraved on these plates.

In the last number of the *Mitteilungen der k.k. Geographischen Gesellschaft*, Vienna, for 1911, Prof. A. Böhm von Böhmersheim discusses the definition of the critical angle of slope of an ocean basin as given by Prof. Krümmel in his recent manual of oceanography. The subject, as well as that of the critical depth, is discussed at length, new definitions are proposed, and formulæ are developed for computing these values, both on the sphere and on the spheroid. Besides the general case, special cases of the Black Sea, the Celebes deep, the Straits of Dover, and the Atlantic Ocean are examined, and the differences between the points of view of the two writers are indicated.

In *The Geographical Journal* for February Mr. W. Harding King describes his journeys into the Libyan Desert to the south-west of Dakhla Oasis. He traversed a consider-

able sandstone plateau rising to an altitude of about 1800 ft., and forming part of the general plain of about 1200 ft. above sea-level, which probably extends to the oases of Kufra, which lie about 400 kilometres to the westward. The vast tract of sand dunes traversed by the Rohlf's expedition in 1874 was found to terminate a little to the north of latitude 25° N., and beyond this there only occurred small patches of drift sand and three of the narrow, but long and persistent, lines of dunes which are so characteristic of the Libyan Desert. The same number gives a summary of the results obtained by the expedition sent to South America by Mr. Bullock Workman to determine the altitude of Mount Huascaran, in Peru, which had been stated to be more than 24,000 ft. M. E. de Larminat measured a base of 1606·6 metres at a height of 3790 metres on the flanks of the chain, levelled up from the Pacific Coast to one of the triangulation stations, and finally obtained triangulated values for the different peaks of Huascaran ranging from 6763 to 6418 metres above sea-level.

THE Hon. Miles Staniforth Smith, Administrator of the Territory of Papua, gave an account of his recent expedition into the western part of the territory before the Royal Geographical Society on Monday, February 12. The expedition entered the hilly country from the end of the navigable portion of the Kikor River, and made its way with great difficulty across the southern portion of a deeply dissected limestone plateau, which rose generally to a height of about 5000 ft. The country was covered with dense jungle, and in the course of the march Mount Murray, the highest peak met with, 8000 ft., was ascended without any view of the summit having been obtained when its foothills were first encountered. The dominant trend of the valleys was north-west to south-east, and along them the expedition marched until it reached a point believed to be near the Strickland River. Being very short of food and water, the mountain slopes had to be left for the valley floor, which proved to be occupied by a rushing torrent flowing between precipitous rock walls. Compelled to build rafts, the expedition was wrecked in the rapids, losing the whole of its instruments, baggage, food supplies, records, and collections, only reaching a base camp of a relief expedition after the greatest hardships. The country is described as the forward edge of an elevated and strongly dissected plateau of coral limestone, in which intrusive basalt occasionally occurs, and the boulders found in the stream bed seem to point to a greater development of this rock to the northward. Part of the plateau is of the "karst" type, water being scarce, streams sinking into swallow-holes, and subterranean river courses being extensively developed. Coal of a hard quality was found at several points, and is ascribed to Carboniferous or Permo-Carboniferous age, but the evidence for this was not stated. The expedition succeeded in maintaining the best relations with the natives, who aided with food and with information, often on very critical occasions.

THE fourth part of the current volume of the *Mitteilungen aus den Deutschen Schutzgebieten* is mainly taken up with the meteorological observations from Togo and from German East Africa for the year 1909. Improved determinations of humidity are obtained by the use of Assmann's aspiration psychrometer at all stations in Togo for the humidity observations, and at several stations in German East Africa. The mean maxima observed at Dar-es-Salam with a radiation thermometer are given for each month for 1899 to 1908. Another article gives a summary of geological investigation in the Cameroons, the principal localities in which mineral deposits have been located being shown on a small map of the colony.

THE synoptic weather charts of the North Atlantic and adjacent coasts for January 11–17, prepared from reports by radio-telegraphy and otherwise, and published in the Meteorological Committee's chart for the current month (first issue), exhibit a very interesting situation. Large anticyclones lay over northern Europe and North America; on January 14 the barometer in Finland rose to 31·2 in. Over the Atlantic the weather remained in a very disturbed state, with frequent south-westerly gales east of longitude 30° W., and strong north-westerly winds on the further side of the ocean; a very deep secondary disturbance gradually embraced practically the whole of the North Atlantic. On the evening of January 14, in latitude 52° N., longitude 30° W., barometer readings were below 28·2 in., just 3 in. lower than over northern Europe. From the latest reports received the Meteorological Office was able to give valuable information as to the probable weather between Ireland and mid-ocean during the next few days.

THE Australian Central Weather Bureau has issued an average rainfall map of South Australia and the Northern Territory, on the same plan as those already published for other States; only stations with at least fifteen years' records have been used. The chart shows clearly the rapid decrease of the rainfall from the agricultural areas northwards to the interior, where, in the Lake Eyre basin, the average annual fall is under 5 in.; the area in square miles in which the fall is under 10 in. is given as 317,600 in South Australia and 138,190 in the Northern Territory. In the latter district the mean annual rainfall is given as 24·65 in., ranging from 62·12 (at Port Darwin) to 5·54 in.; in the Pastoral Interior 7·26 in., ranging from 12·99 to 3·79 in.; in the agricultural settled districts 18·93 in., varying from 46·99 (at Stirling West) to 7·12 in. The line (14–16 in.) representing the limit of safe agriculture is plotted on the map.

THE recent publications of the U.S. Coast and Geodetic Survey include volumes of magnetic observations at the observatories of Porto Rico and Baldwin (Kansas). The Porto Rico volume covers the two years 1907 and 1908. In April, 1907, the magnetographs were moved from a room in Fort Isabel Segunda, on Vieques Island, which they had occupied since their erection in 1903, to a site about a kilometre distant, on Vieques Sound. They were re-erected in a new building, the construction of which is described. It is wholly above ground, but suffices to secure a satisfactorily uniform temperature, the climate having small temperature variations, whether daily or annual. As in previous volumes, particulars are given of the hourly readings of the curves, and diurnal inequalities are derived from ten quiet days a month. Copies are given of some of the most disturbed curves. During 1908 the horizontal force magnetograph had a large drift of zero, and numerous discontinuities also appeared in the curves, so that the records do not seem altogether trustworthy. The second volume gives data for Baldwin from January, 1907, to October, 1909, when the observatory was discontinued and the instruments transferred to a new observatory at Tucson, Arizona. The contents are similar to those of the Porto Rico volume. The copies of highly disturbed traces include that of September 25, 1909, the only magnetic storm during the period included which reached the highest grade of disturbance. Temperature changes in Baldwin Observatory were so large as to be decidedly prejudicial to the working of the magnetographs. The vertical force instrument naturally suffered

most, but even the declination instrument gave trouble at times.

THE leakage of steam past piston valves has formed the subject of a research conducted at Birmingham University by Mr. H. Denzil Lobley, and the results are given in an article in *The Engineer* for February 9. A special jacketed cylinder was used, and could be supplied with either saturated steam or with steam superheated up to 900° F. The valve could be driven at different speeds by means of an electromotor. The principal conclusions are as follows:—(*a*) Piston-valve leakage is not responsible for any appreciable amount of the "missing quantity," or the leakage of a well-fitted piston valve is practically negligible. (*b*) The leakage does not follow the law K=CP/L. (*c*) The leakage diminishes proportionally to the increase of temperature until 500° F. is reached, after which the distortion of the rings causes it to increase. From these results it appears that the piston valve has advantages over the flat slide valve other than those due to the fact that the piston form is balanced. It is probable, and indeed is almost proved by Callendar and Nicholson's experiments, that the great difference in leakage of the two types is owing to the fact that slide valves warp, and thus lift off the face. Warping is eliminated in piston valves, except at high temperatures, and hence the leakage is very small.

MR. FRANK FIELDEN deals with a few problems in bituminous suction-gas plants in *Engineering* for February 9. An examination of the specifications issued by suction-gas plant makers shows that in most cases a good average quality of dry anthracite coal of a certain size is expected to be used to fulfil the guarantees as to fuel consumption and quality of gas to be produced. There are, however, strong incentives to the engineer to construct a suitable suction-gas generator for the satisfactory gasification of native coals, which have hitherto been unemployable for the purpose. Mr. Fielder summarises the ideal suction plant as follows:—It will consume all the volatile matter contained in the coal in addition to the solid carbon; to effect this, some mechanical feeding of the fuel at a regular rate to suit the load on the engine would seem desirable. Caking coal will be so treated as to prevent arching over, and consequent obstruction to an equable air and vapour supply in the main fuel column of the generator. Suitable facilities will be provided for the effectual removal of ash and clinker without interfering with the quality of gas produced; this is essential for all coal used on extended periods of running. It is, of course, assumed that the ordinary factors will also be considered, such as amount of space occupied, simplicity of construction, minimum amount of attention, and reasonable first cost.

OUR ASTRONOMICAL COLUMN.

THE CHANGES ON SATURN'S RINGS.—From the current number of *The Observatory* we learn that Prof. Todd claims an alternative translation for his telegram (which was in Latin) concerning the changes on, and probable "dissipation" of, Saturn's rings. It is suggested that the term "dissipation" did not refer to the actual rings.

EPHEMERIS FOR BORRELLY'S COMET, 1911*c*.—In No. 4552 of the *Astronomische Nachrichten* M. Fayet gives a bi-daily ephemeris for comet 1911*e* extending to May 13. The comet is at present in Perseus (R.A.=3h. 54·8m., $\delta=+45°\ 57'$), and is travelling towards Auriga in a direction slightly north of east; it is, however, very faint, and is receding from both the earth and the sun.

STELLAR SPECTRA IN THE VISUAL REGION.—Although the photographic spectra of many stars have been more or less exhaustively studied in the region more refrangible than $H\beta$, the study of the less refrangible region has been restricted, except for a few of the brighter stars, by the lack of sensitiveness of photographic plates in that region. An attempt to remedy the omission appears in No. 4552 of the *Astronomische Nachrichten*, where Dr. Hnatek publishes reductions of the spectra of γ Andromedæ, α Cassiopeiæ, α and γ Cygni, and α Persei in regions less refrangible than λ 4861. The spectra were taken in 1907, for another purpose, by Herren Eberhard and Ludendorff with Spectrograph V. of the Potsdam Observatory; pinacyanol-bathed plates, by Wratten and Wainwright, were employed, but the spectra are still under-exposed.

The reductions are not very exhaustive; for example, Dr. Hnatek gets nine lines in the spectrum of α Cygni between λ 4861 and λ 5316·85, whereas the South Kensington published reduction gives twenty-eight. Further, he gives, generally, Rowland's origins and intensities, which in an "enhanced-line" star do not represent the facts; only occasionally does he refer to the enhanced lines published by Lockyer, and thus at times misinterprets the significance of an origin, or an exceptional intensity, of a line. For each star he has deduced from his measures the radial velocities at certain epochs, which he tabulates at the end of the paper.

STELLAR PARALLAXES.—A second series of stellar parallaxes, determined from meridian transits at the Washburn Observatory, Wisconsin, is published by Mr. A. S. Flint in No. 631 of *The Astronomical Journal.* The observing list consisted primarily of stars between magnitudes 1·5 and 2·5, but some fainter stars were added, and in the final list are given the parallaxes of 124 stars. Among the brighter stars the following large positive parallaxes are given:—β Persei, $+0{\cdot}130''$; α Persei, $+0{\cdot}109''$; β Canis Maj., $+0{\cdot}163''$; α Geminorum (pair), $+0{\cdot}174''$; γ Leonis, $+0{\cdot}105''$; β Ursæ Maj., $+0{\cdot}136''$; α Serpentis, $+0{\cdot}151''$; and α Ophiuchi, $+0{\cdot}127''$; while the 3·7-magnitude star ϵ Eridani has a parallax of $+0{\cdot}379''$ in Mr. Flint's list. A general average of the probable errors of the final parallaxes is $\pm 0{\cdot}031''$, and after discussing the data in a number of different ways Mr. Flint concludes that the parallaxes given are sensibly free from systematic error.

THE SPECTRA OF COMETS.—The February number of *L'Astronomie* contains an interesting paper in which Comte A. de la Baume Pluvinel discusses the spectra of comets, more especially as revealed by the researches of the past few years.

After briefly summarising the earlier observations, he describes at length the spectrum of the Morehouse comet, and reproduces an excellent comparison showing the close identity of the doublets in that spectrum with doublets occurring in Prof. Fowler's spectrum of carbon monoxide at low pressure.

In conclusion, he points out that to answer the question, "What are comets made of?" would have been comparatively simple, say, a dozen years ago, but to-day the photographic method has revealed so much that was then unknown that the answer is not so easy. The composition of comets is complex, and all comets do not display the same composition. As our knowledge extends still further it may become necessary to classify comets in spectral classes; in fact, this has already been done in a simple fashion. Some comets are essentially gaseous and blue, *e.g.* Morehouse; others, like the great comet 1910*a*, are yellow, and contain much solid matter.

THE PARALLAX AND PROPER MOTION OF MIRA.—In No. 44 of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowa* Herr S. Kostinsky discusses at length the parallax observations of Mira made by him during the period 1903–7. The main discussion is printed in Russian, but there is a *résumé* in German, in which the principal stages and results are described.

Among other results, the author finds that the yearly parallax of Mira is probably zero, and in any case does not exceed $+0{\cdot}05''$. The yearly proper motion in R.A. is extremely small, and in declination is about $-0{\cdot}235''$.

CONTRIBUTIONS TO THE ETHNOLOGY AND ARCHÆOLOGY OF NORTH AMERICA.[1]

SO little information is available concerning the Indian tribes of the Lower Mississippi Valley and the adjacent coast of the Gulf of Mexico that Mr. Swanton's memoir is very welcome. In it he has published extracts from early French authors, and in a compact form we have all that is known about tribes now extinct or reduced to a few, much modified, survivors. There are seven linguistic families around the Lower Mississippi; of these, the Caddoan and Siouan are extensions or outliers of a wider distribution; the Muskhogean group extends in a broad band to the Atlantic; to this is related the small Natchez group. The Chitimachan people live at the mouth of the river, while westwards extend the cognate Atakapan

FIG. 1.—Blowpipe and cane arrows. The end of the blowgun has been ornamented by burning and the arrows feathered with down from the fireweed.

group, to which, probably, the small Tunican group are also allied.

By far the greatest space is given to the Natchez group, the authorities on which are quoted at length, a plan which has much to recommend it, though it leads to a certain amount of repetition, and the conflicting accounts cannot always be reconciled. Head-flattening occurred, and both sexes were freely tattooed, but the men only after having killed some enemy. The principal animals hunted were the bear, deer, and bison; agriculture had attained great importance; the cultivation of maize was done in common, pumpkins, water melons, tobacco, and probably beans were also grown. The work and play of the sexes is described. There was great licence before marriage. There was a peculiar, strongly centralised form of government; the great chief is called Great Sun; his heir is the son of the woman nearest related to him; his relations were little suns; nobility was reckoned through the females, but by the seventh generation nobles gradually sunk to the rank of stinkards or commoners. Princesses of the blood

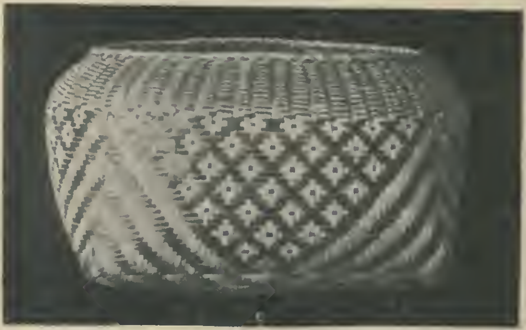


FIG. 2.—Chitimacha basketry. This design of large white spots with dark centre is called *tcêxt-kani*, "blackbird's eye."

always espoused men of obscure family, and had but one husband, who might be dismissed at will. The community consisted of (i) nobility of three ranks: (1) suns (children of sun mothers and stinkard fathers); (2) nobles (children of noble mothers and stinkard fathers, or of sun fathers and stinkard mothers); (3) honoured people (children of honoured women and stinkard fathers, or of noble fathers and stinkard mothers); and (ii) stinkards (children of stinkard mothers and honoured men, or of stinkard fathers

FIG. 3.—Betatakin—western end

and mothers). The Great Sun was practically treated with divine honour.

The harvest feast was the most solemn of all; essentially it consisted in eating in common, and in a religious manner, new corn which had been sown for that purpose by warriors, with the great war chief at their head; the Great Sun presided at the feast. The war customs are described: "The great war chief pays to the family for

[1] Smithsonian Institution. Bureau of American Ethnology. Bulletin No. 43: "Indian Tribes of the Lower Mississippi Valley and Adjacent Coast of the Gulf of Mexico." By J. R. Swanton. Pp. vii+387+32 plates. Bulletin No. 50: "Preliminary Report on a Visit to the Navaho National Monument, Arizona." By J. W. Fewkes. Pp. iv+35+22 plates. (Washington: Government Printing Office, 1911.)

those whom he does not bring back, a circumstance which renders the chiefs more careful in leading their warriors." Smoking the calumet is associated with preparation for war and with peace treaties. The Natchez language appears to be the result of a mixture between a Muskhogean and a non-Muskhogean people.

The Chitimacha were less warlike and more cowardly than the tribes higher up the Mississippi; their culture differed from the latter principally by the increased importance of food from the waters and the decreased importance of food from land animals; but wild vegetable food was their mainstay, though they cultivated maize and sweet potatoes. Fish were caught mainly with hook and line, but nets and traps were used. The blowpipe was employed, the darts of which were made of slender pieces of cane feathered with thistledown (Fig. 1). Pottery was made: but the chief glory of the Chitimacha was, and still is, their basketry (Fig. 2). Like some other tribes of the district, there were nobles and commoners, with different terms of etiquette for each; but, unlike the Natchez, their nobles were constrained to take partners from their own ranks, thus forming a caste. Matrilineal totemic clans existed. Every village of any size had a bone-house, in which a fire was kept continually burning. The bones of people were dug up by "turkey-buzzard men" and kept in the house for some time, and finally buried in a mound. Every large village had also a dance-house for religious and social ceremonies, as, for example, the initiation of boys. Different from this was the solitary fast and confinement which each boy (and, it is said, each girl also) underwent in order to obtain a guardian spirit. The so-called "temples" of the Natchez and other Lower Mississippi tribes were only variants of the bone-houses of the Chitimacha and Choctaw. Further study may be expected to throw light upon the evident fusion of at least two stocks in the tribes recorded by Mr. Swanton. A number of old illustrations are reproduced, but many of the photographs are not very satisfactory; there is a useful map.

The excellent archæological work of Dr. Fewkes in exploring and conserving cliff-dwellings has been referred to already in NATURE. In Bulletin 50 he gives an account of his stewardship of the Navaho national monument in Arizona. The excellent illustrations to his report bring home to the reader the great interest of these remarkable remains (Fig. 3). He makes some suggestive remarks upon the significance of the dwellings. "The ancients chose this region for their homes on account of the constant water supply in the creek and the patches of land in the valley that could be cultivated. . . . Defence was not the primary motive that led the sedentary people of this canyon to utilise the caverns for shelter . . . the cause of their desertion was not so much due to predatory enemies as failure of crops or the disappearance of the water supply." Dr. Fewkes does not regard these ruins as of great antiquity; such evidence as has been gathered supports the Hopi legends that the inhabitants were ancient Hopi belonging to the Flute, Horn, and Snake families.

A. C. HADDON.

BACTERIAL DISEASES OF PLANTS.

THE second volume of Dr. E. F. Smith's work upon bacteria in relation to plant diseases, published by the Carnegie Institution of Washington, comes very opportunely to this country at a time when there are signs of an awakening interest in the subject of bacterial diseases of plants, and botanists, especially those interested in agriculture or horticulture, are beginning to turn their attention to the many economic problems in connection with this branch of phytopathology. The first volume, published in 1905, the author states, "had for its aim only the clearing of the ground by a discussion of methods of work in the general subject of bacteriology."

Although this department of botanical study is only some thirty years old, a considerable literature has arisen, even when the subject is taken in its narrowest sense, but when it includes, as in this case, many correlated topics, the list assumes large dimensions. Everyone interested in plant pathology will be grateful to Dr. Smith for bringing these papers together and for giving us a book of reference which has been long needed, and which embraces a concise historical account, leading up to the present position of the subject and embodying the most recent developments in this branch of research. A special feature of the book is the author's plan of including abstracts of many of the papers quoted, often of very considerable length, so that direct appeal can thus be made to original investigations; and although this method demands much space, the advantages are great, especially where controversial matter is being considered. Thus, under each sectional head, the author introduces extensive extracts from those original papers which he regards as critical studies, and concludes with a synopsis of the latest contribution to the particular phase of the question dealt with, adding always an extremely valuable bibliographical record. In the historical review Dr. Smith has missed the fact that the existence of a toxin and cytolytic enzyme secreted by the attacking bacterium was proved as early as 1890 as regards the "soft-rots," and in conjunction with carefully conducted

FIG. 1.—Crown gall on daisy.

Two tumours on the stem of a Paris daisy as the result of an inoculation of *Bact. tumefaciens* by needle-pricks, and on a branch above the upper one a secondary tumour on the petiole of a leaf. Age of primary tumours about three months; that on the leaf is much younger, perhaps four weeks old.

inoculation experiments; thus the bacterial nature of this class of diseases was fully established at that date.

The present treatise covers a wide field, and questions relative to the action of bacteria upon various tissues, the reactions of the plant, the interrelations of animal and plant parasites, individual and varietal resistance, and problems relating to prevention, come naturally within the scope of the work. A discussion of the various theories regarding the root-nodules of the Leguminosæ, and the question of symbiosis as it touches parasitism, are also usefully introduced, and the large chapter devoted to this relationship presents a valuable summary of results. But a *résumé* of conflicting views concerning bacterial symbiosis in insectivorous plants can scarcely be included under the titular definition of the book, nor the bacterial symbiosis in Cryptogams, as, for example, in kephir and the ginger-

beer plant. Though exceedingly interesting and important to botanists, these discussions are rather foreign to the main theme, and might with advantage have given place to a further treatment of definitely established diseases, and more unity and balance would thus have been secured.

In seeking for some convenient classification of various diseases, the natural division into three large groups is adopted:—(1) the vascular diseases; (2) the parenchyma diseases without hyperplasia; and (3) cankers, tubercles, and tumours, in which there is a more or less distinct hyperplasia. Under the general considerations involved in a study of these forms of parasitism, such as the methods of infection and progress of the disease, the destruction of tissues and dissolvent action of enzymes, abnormal development of host tissues, &c., a great number of bacterial diseases are dealt with by way of illustration, but only three specific diseases are fully described as such. These —the wilt of cucurbits, the black-rot of cruciferous plants, and the yellow disease of hyacinths—belong to the vascular group, and are discussed in fullest detail with respect to the specific characters of the organism, the etiology of the disease, the morbid anatomy, geographical distribution, and remedial treatment, including an estimate of financial loss for which they are responsible. The account of the cucurbit wilt represents Dr. Smith's own work, and he has

FIG. 2.—Wilt of cucurbits.

1. Cucumber-plant infected with a pure culture of *B. tracheiphilus* plated from the stem of a squash-plant. Plant inoculated August 10, 1905, by needle-pricks on blade of leaf marked ×. Photograph made on August 22. The vessels of the stem were plugged with a sticky white bacillus, which was plated out. Surface of stem sound. About one-sixth natural size.
2. Cucumber-leaf inoculated with *B. tracheiphilus* by *Diabrotica vittata* night of August 17, 1905. Blade shrivelled in some places and wilting in others. A natural infection. Photographed August 26, about half-size.

also carried out much original research upon the other special diseases enumerated. The three are placed each in separate chapters, and together occupy more than one-third of the whole volume. Perhaps we may look forward at some future date to a third volume dealing more completely with other important types.

The most notable recent work on bacterial disease is that by Dr. Smith upon the crown gall, and a very interesting epitome of his latest paper is included here. This brilliant piece of investigation has established beyond all question that the tumerous disease known as the crown gall (Fig. 1) is of bacterial origin, and the phenomena in connection with this type of bacterial disease appear, in the author's own words, "to throw a flood of light on the mechanism of the development of malignant animal tumours."

The book is fully illustrated by expressive drawings and photographs, made chiefly from material in the author's own laboratory. Two of the illustrations are here reproduced.

M. C. P.

THE PROGRESS IN OUR KNOWLEDGE OF THE TRANSMISSION OF SLEEPING SICKNESS AND OTHER TRYPANOSOME DISEASES IN AFRICA.[1]

THE latest report of the British Sleeping Sickness Commission is the outcome of the work of Colonel Sir David Bruce, Captains A. E. Hamerton, H. R. Bateman, F. P. Mackie, and Lady Bruce, the members of the third commission to Uganda during the years 1908–10. It is highly satisfactory to find that, in the volume before us, a distinct advance is recorded in our knowledge relating to important etiological questions connected with the spread of sleeping sickness and of certain animal diseases due to trypanosomes.

An introduction, illustrated by photographs, describes the chief features and arrangements of the camp at Mpumu, which was made the headquarters of the commission. The body of the work is divided into ten sections, the more important sections each comprising several groups of experiments. In a few cases these subdivisions represent the continuation or elaboration of an experiment previously recorded (in Report No. x.); in such, the result obtained from the original experiment is first of all briefly recapitulated. At the end of the volume is a comprehensive analytical index (to both Reports x. and xi.) which will be found very useful.

The first section (A), which is in many respects of the greatest interest, deals with the development of *Trypanosoma gambiense* and other trypanosomes in *Glossina palpalis*, and the question of their transmission by this tsetse-fly. As regards *Trypanosoma gambiense*, the following important conclusions are reached by the commission. Mechanical transmission, that is to say, transmission by means of interrupted feeding, plays a much smaller part, if any, in the spread of the parasites (and consequently of sleeping sickness) than has hitherto been supposed. After the first few hours, the bite of the fly was found to be non-infectious until at least twenty-eight days had elapsed since the fly fed on the original infected animal.[2] At the end of this "incubation period" the fly may become infective, and may retain its infectivity for at least ninety-six days. This means that the developmental cycle of the parasites in the insectan host was found to take about twenty-eight days, and only when this development was completed could the infection be transmitted back again to the vertebrate host. Once a fly becomes infective, it appears only too likely that it may remain infective for the rest of its life. On the other hand, against this alarming result may be set the fact that only a small proportion of flies (laboratory bred) appear to become infective, the commission having found that the trypanosomes develop only in about 1 in 20 of such flies fed on an infected animal; and the proportion of infective to non-infective flies occurring wild in nature is very much less, probably not more than 1 in 500. An interesting account is given of the various developmental phases of the parasites observed in the different organs of the fly. Stress is laid by the commission upon one fact, namely, that in the salivary glands, and in them alone, were the trypanosomes found to revert to the blood-type. Further, the occurrence of this type of the parasites in the salivary glands was found to coincide, broadly speaking, with the onset of permanent infectivity of the fly. The commission consider that without this invasion of the glands there can be no infectivity, and that the reversion of the parasites to the blood-type is

1 Reports of the Sleeping Sickness Commission of the Royal Society. No. xi. Pp. 294+15 plates, text-figures, and maps.

2 It may be mentioned that Kleine and Taute, associated with the German sleeping-sickness Commission, have found that flies may become infective about twenty days after being fed. This variation in the incubation-period is probably dependent on variations in the surrounding conditions, food, &c.

a *sine qua non* in the infective process; in other words, the stumpy type of form developed in this situation is regarded as the essential propagative phase. It should be mentioned, however, that the commission found also that injection of the intestines only of infected flies, after twenty-four days or more had elapsed since feeding, produced an infection in some of the inoculated animals. Hence either the blood-type must occur in the intestine also,[3] or else some other form or phase is also capable of transmitting the infection. With regard to the latter possibility, there is one point upon which we should like to comment. A characteristic type of parasite, long and very slender and possessing a peculiar elongated nucleus, was found, but not very commonly, in the fore-gut or proventriculus at intervals after twenty days. This very distinct type of form is known to occur also in the life-cycle of other trypanosomes, from widely different vertebrates, when in the invertebrate host; it has been described, for instance, in the case of *Trypanosoma brucii* in *Glossina fusca*, in the case of fish trypanosomes in leeches, and in the case of an avian trypanosome in a mosquito; in these cases it is either known with certainty to be the propagative phase or else is regarded with some probability as such. We think, therefore, that the fact of its occurrence in *Trypanosoma gambiense*, as described by the commission, should be noted, and the possibility that it may be a propagative form also in this case borne in mind. At any rate, the occurrence of this type in very different species of trypanosomes suggests that it has an important significance.

It is interesting to compare with the above account of *Trypanosoma gambiense* in *Glossina palpalis* the relations of *Trypanosoma vivax*, a dangerous parasite of cattle, to the same species of tsetse-fly, on which light has also been thrown by the commission. Flies were found to be able to transmit *T. vivax* after an incubation period of from seventeen to twenty-eight days, a shorter period, it will be noticed, than in the case of *T. gambiense*. The parasites develop, moreover, in a much larger percentage of flies—in about 20 per cent. A striking point of difference is that the development is restricted to the proboscis and pharynx of the fly, where the parasites occur in large numbers;[4] and, further, the predominating type of form met with is not, as in the other case, trypanosome-like. From this brief comparison it will be realised how greatly the developmental cycles of different species may vary even in the same insectan host.

The second section (B) consists of series of experiments designed to ascertain if, among various animals, including cattle, antelope, &c., there are any which can be regarded as a reservoir or source of *T. gambiense*; and the results obtained by the commission have already attracted considerable attention, and may prove ultimately to be of great economic importance. The conclusion arrived at is that it is possible both for cattle and antelope living in a fly area to act as a reservoir, and so maintain the infectivity of *Glossina palpalis* in regard to sleeping sickness; but up to the present the commission has not been able to prove that this actually takes place in nature. The facts brought forward in this connection, however, are very suggestive. In antelope the parasites are extremely scarce and difficult to find by microscopic examination of the blood, even when the animal was proved by experiment to be infective for flies. In one instance a buck was shown to remain infective for nearly three months. Infected animals remained apparently in good health, even though kept in captivity (in one case for at least four months). It is evident that in antelope and cattle the infection produced by *Trypanosoma gambiense* is of the chronic type, and apparently similar in character to the infection of wild game by *T. brucii*. In addition, there is the fact, shown by the commission, that the tsetse-flies from the lake-shore have now remained infective for three years since the removal of the population, the zone being given over to the wild game. Unfortunately, the commission was able to shoot only five buck, which were negative in respect of *T. gambiense*; from such a small number it was impossible, of course, to draw any conclusion. If the further investigation undertaken by Sir David Bruce proves that the wild game in the district is naturally infected with the parasites, a very serious etiological factor is introduced, since the removal of infected human beings from the zone of the fly will not be sufficient to cause the disappearance of the trypanosome.

We have dealt somewhat at length with the first half of the report in view of the widespread interest and importance attaching to all research that bears in any way upon the serious question of sleeping sickness. Consequently, we are unable to refer as fully as might be desired to the remaining half of the volume, which contains much that should be noted by workers on trypanosomes and trypanosomoses in general. It must suffice to indicate briefly the scope of the other sections, permitting ourselves to remark upon one or two particular experiments.

The third section (C) describes series of miscellaneous experiments carried out, for the most part in connection with *Glossina palpalis*. One of these series (No. 22) was to ascertain if laboratory-bred *G. palpalis* become infected with flagellates when kept in the same cage with, or in contact with cages containing wild flies infected with, *Trypanosoma grayi*. The commission found that the laboratory-bred flies did not become infected with *T. grayi* (or other flagellates) after being kept for six weeks in association with the infected flies, and after having had ample opportunity to foul their proboscides with the excrement of the wild flies. *T. grayi* is known to form cysts, which presumably pass out with the dejecta of the fly; hence the above evidence, so far as it goes, points to the flies not becoming infected directly from the cysts, the function of which remains to be determined. The idea originally put forward by Minchin was that they might serve for a contaminative infection of the vertebrate host.

Section D is devoted to a consideration of certain well-known disease-causing trypanosomes of cattle in Uganda. Much attention is paid to the morphological characters of the different forms, and the limits within which they vary in the case of "strains" from different districts, with the view of distinguishing clearly between different species. A trypanosome found in oxen from a particular locality is regarded as a new parasite, and named *T. uniforme*. Section E consists of experiments designed to ascertain if certain Tabanidæ act as the carriers of *Trypanosoma dimorphon* (termed by the commission *T. pecorum*). Species of Tabanus were apparently unable to transmit this parasite "mechanically," but these flies did not live long enough in captivity for it to be determined whether they could act as true hosts or not. We may point out that the flagellate parasites which were found in some of the (wild) Tabanids were most probably phases in the life-cycle of a trypanosome of some vertebrate, quite possibly a natural (*i.e.* harmless) parasite of the cattle themselves;[5] such a form would not be likely to live in rats. Sections F and G describe trypanosomes (including new species) and other parasites from various animals. Section H is concerned with the disease of natives known as "Muhinyo," which turns out to be Malta fever. Section I is a very useful account of the distribution, so far as it is known up to the present, of biting flies in Uganda, illustrated by a map in the case of the more important species. Lastly, Section J, together with the appendices, furnishes an epitome of the commoner diseases of cattle occurring in the different districts of the Uganda Protectorate.

It will be evident from the above digest that a mass of very useful information is contained in the latest report, which in our opinion is one of the most valuable of the series. No elaborate study of the numerous experiments is required to realise the very considerable amount of time and labour their prosecution must have entailed. The members of the commission are to be congratulated on the addition of an important quota to the ever-growing sum of our knowledge of the devastating trypanosome diseases of tropical Africa.

[3] Kleine and Taute found blood-forms (apparently not quite corresponding, however, to those referred to above) in the intestine of most of their infective flies. Further, these workers do not attach much importance to the presence of the parasites in the salivary glands; in view of the marked correspondence shown by the British Commission between the period when the Trypanosomes were found in the glands and the time when the flies became infective, this discrepancy is difficult to explain.

[4] This localised type of development has been termed by Roubaud "évolution par fixation directe."

[5] Knuth and Rauchbaar have recently shown that a Trypanosome occurs naturally in cattle in Germany; this is most likely transmitted by Tabanids (*e.g.* Hæmatopota spp.), from which, in fact, flagellate phases have long been known.

INDIAN FOSSILS.[1]

THE Geological Survey of India has done good service both to stratigraphical geology and to palæontology by entrusting to Messrs. Cossmann and Pissarro its collection of Mollusca from the Ranikot beds of Sind. These are the only undoubted Lower Eocene strata hitherto discovered in India, and an authoritative comparison of their fossils with those of the corresponding European formations is of great interest and importance. Most of the specimens described are from the zone of *Nummulites planulatus*, and a large proportion of them were collected by Mr. E. W. Vredenburg, who contributes some preliminary stratigraphical notes to Messrs. Cossmann and Pissarro's memoir. The corals of the same formation were determined many years ago by Prof. Martin Duncan, while the Echinoids were described by Duncan and Sladen.

The general geological results obtained from the new study of the Mollusca accord closely with those reached by these earlier authors from their examination of the other groups. There are numerous specimens of Velates, a genus which specially characterises the Lower Eocene of Europe. Some species of Calyptrophorus are closely similar to those from the Eocene of North America, and there are many interesting forms of Volutilithes, Ampullina, and Rimella. There are also several specimens of *Styracoteuthis orientalis*, a curious dibranchiate cephalopod previously known only by a single example from the Eocene of Arabia.

The second part of the late Prof. Victor Uhlig's memoir on the Ammonites of the Spiti Shales (Upper Jurassic) of the Himalaya consists mainly of technical descriptions of species, illustrated by a fine series of lithographed plates. There are, however, interesting discussions of possible lines of development among the genera, subgenera, and species of the Hoplites group and the Macrocephalites group. Many genera of Ammonites found in the Spiti Shales exhibit no very close relationship to those of Europe, but among the species of the genus Hoplites it seems possible to recognise a series of well-known European types. Moreover, it is remarkable that these species in Europe are partly Lower Neocomian, and even range upwards to the lowest zone of the Middle Neocomian. In the Macrocephalites group Prof. Uhlig identifies species of Simbirskites, which is also a Lower Cretaceous genus in Russia, North Germany, and England. The large majority of the so-called new species are represented only by a single imperfect specimen, and the differences between many of them are so difficult to appreciate that the wisdom of multiplying names in such cases may be doubted. The study of Ammonites is obviously making great progress, but much of it is obscured by injudicious nomenclature.

[1] "Paleontologia Indica, being Figures and Descriptions of the Organic Remains procured during the Progress of the Geological Survey of India." New series, Vol. iii., Memoir No. 1., The Mollusca of the Ranikot Series, Part 1., Cephalopoda and Gastropoda, by M. Cossmann and G. Pissarro; Introductory Note on the Stratigraphy of the Ranikot Series, by E. W. Vredenburg. Pp. iv+xix+83+viii plates. Price Rs. 2 or 2*s*. 8*d*. Series xv., Himalayan Fossils, Vol. iv., The Fauna of the Spiti Shales. Fasciculus 2, by Prof. Dr. V. Uhlig. Pp. 133–306+plates xix–xlviii*a*, and lxxvii–xci. Price Rs. 12.4 or 16*s*. 4*d*. (Calcutta: Geological Survey Office, 1909 and 1910.)

JUVENILE EMPLOYMENT AND CONTINUATION EDUCATION.

DURING recent years the efforts of reformers of our national system of education have been concentrated to a considerable extent upon two great problems, namely, the early age at which education ceases for most boys and girls, and the entry of so many boys into "blind alley" industries, resulting a few years later in their being thrown, unqualified and unskilled, upon the labour market. With regard to continuing elementary education to a later date, but little progress has been made of recent years. Unfortunately, Mr. Runciman's Bill of 1911, dealing with questions such as the raising of the "leaving age," the abolition of "half-time," and compulsory attendance at continuation schools, was not pressed through, and no intimation has yet been given that the Government intends to bring into operation, if possible, even one of the reforms covered by the Bill of 1911.

Considerable progress is being made, however, in the direction of attempting to lessen the evils of the "blind alley" industry. It is obvious this can best be done by acquainting parents with the future prospects offered by the various trades or callings into which the boy may enter on leaving school, by personal advice as to the necessity of attending continuation classes and the educational course it is best for the boy or girl to pursue when attending evening classes. The first public recognition of this was the Education Act of 1908 for Scotland, authorising the School Boards of Scotland to maintain voluntary agencies which should advise boys and girls upon the suitable employments open to them on leaving school. Later in the same year clauses were inserted in the Labour Exchanges Bill authorising the Board of Trade to establish Juvenile Labour Exchanges. Somewhat later, the Education (Choice of Employment) Bill gave powers to the English and Welsh education authorities "to give boys and girls information, advice, and assistance with respect to the choice of employment." This duplication of powers to the Board of Trade and the education authorities, respectively, gave rise to some friction at first; but this has now been smoothed away, the Board of Trade only exercising its powers independently if the education authority decides not to put the Act in operation.

Already a number of local education authorities have prepared schemes for the exercise of their powers under the Act. The schemes provide for the cooperation of the Labour Exchanges of the Board of Trade with local committees nominated by the education authority. The Board of Education has formally approved of the schemes proposed by the Liverpool and Birmingham Education Authorities respectively. It is understood that about twenty other authorities have submitted schemes for approval, and that a number of other authorities are preparing schemes at the present time.

The success of the Act will depend mainly, of course, upon the local committees appointed to carry out the duties imposed upon them by the Act. Apparently these committees will contain a fair sprinkling of representative local employers, social workers, elementary teachers, and the like. It is important that due representation should be given, if possible, to those with firsthand knowledge of continuation and technical school work, in order that the best possible advice be given respecting attendance and courses of work at evening continuation and technical schools.

In further support of the agitation to limit the evils of the "blind alley" occupation, a long letter appeared in the daily Press on Thursday, February 1, signed, among others, by the Bishop of Hereford, Mr. Cyril Jackson, Mr. Ramsay Macdonald, M.P., Mr. J. L. Paton, and Dr. M. E. Sadler. In this letter attention is directed to such facts as that van boys work, on an average, from 96 to 100 hours per week, and that only about 36 per cent. of these boys secure positions later as carmen. About 53·7 per cent. of recruits from London for the Army began life as van boys and errand boys. It is clear from the long hours worked by van boys and the like that attendance at continuation schools is impossible. The signators of the letter recommended that boys engaged in such callings as those just mentioned should, between fourteen and eighteen years of age, be permitted to work only for thirty hours per week, and be compelled to attend continuation schools for another twenty hours.

Incidentally, it may perhaps be suggested that sometimes educational institutions such as university colleges, medical schools, and technical schools, are not entirely guiltless on these questions of "blind alley industries" and the lack of facilities for continued education given to the boys passing direct from the elementary schools to the position of assistants in the laboratories or workshops of the colleges or schools.

J. WILSON.

THE PRESSURE OF A BLOW.[1]

THE scientific analysis of a blow requires, first, the determination of the actual pressures or forces set up between the colliding bodies, and, secondly, an investigation of the distribution of these pressures and of their physical effects. The pressure produced by a blow does not differ in kind from that produced by any other agency, such as

[1] Discourse delivered at the Royal Institution on Friday, January 26, by Prof. Bertram Hopkinson, F.R.S.

an hydraulic press, but it differs in degree because of its great intensity and of its extremely short duration, and these characteristics, as we shall see, have a marked influence on the effects which it produces.

The first part of the problem, that is, the calculation of the pressure in tons or pounds, is based on the familiar principles of mechanics which were first precisely stated in Newton's laws of motion. The cause of the pressure is the rapid change of motion of the colliding bodies which occurs when they come into contact, and, according to Newton's second law, the force is simply proportional to the rate at which this change is effected. The rate of change may be measured in terms of energy and distance or in terms of momentum and time. Thus a hammer head moving at a rate of 16 feet per second, and weighing 1 lb., possesses 4 foot-lbs. of energy, because its velocity could have been acquired by falling freely through 4 feet. If it strikes a nail and drives it one-eighth of an inch, the energy which was generated by the weight of 1 lb. acting through 4 feet is destroyed in 1/400 part of that distance, and the force necessary to effect this change of motion is 400 times as great—say, 400 lbs. The same effect would be produced by a 4-lb. hammer striking with the velocity which would be acquired by falling through 1 foot, namely, 8 feet per second. Regarding the same instance from the point of view of momentum, the 1-lb. hammer would take half a second to fall 4 feet, and the quantity of motion or "momentum," reckoned as the product of the force acting into the time required to generate it, would be one-half of a pound-second unit. While driving the nail in, the hammer covers a distance of ⅛ inch with a velocity which starts at 16 feet per second and drops to zero. To cover the distance of ⅛ inch with the average velocity of 8 feet per second takes 1/800 of a second, which is 1/400 of the time (½ second) which it takes the weight of the hammer head (a force of 1 lb.) to generate its motion. Thus the pressure required for the rapid stoppage is, as before, 400 lbs.

We may take another instance essentially similar to the hammer and nail, but differing greatly as regards scale. A 14-inch armour-piercing shell weighs about 1400 lbs., and when moving at 1800 feet per second possesses about 31,000 foot-tons of energy, or about 15,000,000 times as much as our hammer head. Such a shell would just pierce a plate of wrought iron 2½ feet thick, and the average force which must be exerted to pull it up in that distance, which is, of course, the pressure which it exerts on the plate, is 30,000 divided by 2½, or about 12,000 tons. This is equivalent to some 80 tons on the square inch.

When a hammer strikes a nail, the force acting during the blow is practically constant, and the average value obtained as above by dividing the energy by the distance moved, or the momentum by the time taken, is equal to the actual force exerted throughout the impact. In many cases, however, this force is not constant, and it is then necessary to divide the course of the impact into short intervals either of space or of time, calculate the change of energy or momentum in each, and add the result. A familiar instance is that of two billiard balls. We may suppose one ball to strike the other full with a velocity of 16 feet per second, which corresponds to a fairly hard stroke. It simplifies the consideration of the problem if instead of one ball moving and the other at rest we suppose them to be travelling in opposite directions with equal velocities of 8 feet per second. At the instant when the balls first touch there is no pressure between them, but as they continue to approach each flattens the other at the point of contact. The balls no longer touch at a point, but over a circular area which rapidly increases in diameter. Corresponding to any given amount of flattening or distance of approach, there is, of course, a definite pressure, which might be measured by actually squeezing the balls together under known forces and measuring the corresponding amount of approach. Or the relation between pressure and distance could be calculated, as was done by Hertz. The area of the curve connecting pressure and distance up to any point gives the number of foot-pounds of energy destroyed. When this is just equal to the original energy of the balls they will have been reduced to rest, and in the case supposed the distance of approach is then 14/1000 of an inch, and the total pressure between them 1300 lbs. This pressure is distributed over the circle of contact, which is one-sixth of an inch in diameter, and the average intensity of the pressure is 27 tons per square inch. The distribution, however, is not uniform, the pressure at the centre being 1½ times the average. The balls are then like compressed springs, their original energy of motion having been completely transformed into strain energy in their substance. The reason of the high intensity of pressure developed is that this strain energy is concentrated into a very small volume of ivory near to the point of contact. The balls then begin to separate, and the whole process of compression is gone through in reverse order, the strain energy being transformed back into energy of motion by the pressure. Finally, the balls rebound unstrained, with nearly the velocity with which they approached.

If for the ivory balls we substituted hollow balls of steel having the same mass, the pressure produced by the blow would be greater, because the steel is much more rigid than ivory, and gives less under a given force. Thus the distance of approach is less, the circle of contact smaller, and the maximum intensity of pressure much greater. It reaches 280 tons per square inch averaged over the surface of contact. Such a pressure could only be sustained without permanent effect by a very hard steel. Ordinary mild steel would begin to flow when the pressure passed about 100 tons, a permanent flat would be left by the blow, and the balls would rebound with less velocity than that of approach. The theory the results of which I have given does not, of course, apply to such a case, as it depends on the assumption of perfect elasticity.

It is rather remarkable that materials can sustain without injury such large pressures as are produced by these blows. Mild steel balls are not crushed perceptibly until the pressure reaches 100 tons per square inch, yet a short column of the same steel would be crushed by a pressure of 30 tons per square inch. One reason is the extremely short duration of the pressure—it has no time to produce much effect. The other is the fact that in the blow it is accompanied by large lateral pressures exerted by the metal surrounding the area of contact. Pressure equal in all directions, such as is exerted by the water at the bottom of a deep ocean, produces generally no permanent effect on solids or liquids. To produce breakage or permanent deformation there must be difference of pressure in different directions, and the most important, if not the only, factor determining whether such breakage or deformation shall occur is the amount of the difference. If, for example, our column of mild steel, which in the absence of lateral support begins to crush at 30 tons, were surrounded by a jacket exerting a radial pressure of 30 tons, it is probable that the end pressure might be increased to 60 tons without any movement occurring. In the impact of balls the metal surrounding the point of contact, by resisting the lateral expansion of the compressed part, sets up radial pressure of this kind. It can be shown, in fact, that the lateral pressure at the centre of the circle of contact, corresponding to a maximum normal pressure of 100 tons per square inch, is 75 tons per square inch, leaving 25 tons effective for producing deformation or breakage.

These calculations of pressure are based on theory, and it may be asked what direct experimental evidence we have that the theory is correct. It is not, of course, possible actually to measure the pressures over the minute circle of contact between the balls, nor is it possible accurately to measure the amount of the flattening. We can, however, pursue the calculation a little further, and determine the time during which the balls are in contact from the moment when they first touch to the moment at which they separate on the rebound. In the case of billiard balls moving with a relative velocity of 16 feet per second, this time is 1/4000 of a second. A precisely similar calculation can be made for balls of steel or other metal, and it is not difficult to measure in the laboratory the time during which such balls remain in contact. The method is of considerable use in connection with impact problems, and it consists in making the two balls, by their contact, close a galvanometer circuit in which there is also a battery and resistance. A certain quantity of electricity, which is simply proportional to the time of contact, then passes through the galvanometer and produces a proportionate

deflection in it. It has been found that the time of contact measured in this way for steel balls is exactly that predicted by theory, and it may be inferred that the theory is correct in all its details, and that the pressure calculated by its aid corresponds with the facts. This method was first used by Pouillet in 1845, and has recently been brought to great perfection by Mr. J. E. Sears, who showed, among other things, that the relation between pressure and deformation of steel is almost exactly the same when the pressure is applied for an excessively short time, as in the case of impact, as it is when applied steadily, as in a testing machine. The assumption that this is the case lies, of course, at the root of the calculations, and its verification was therefore a matter of considerable importance.

When one billiard ball strikes another the effect of the blow is practically instantaneously transmitted to every portion of the colliding balls, or, to speak more precisely, the time taken to transmit the pressure is short compared with the total time of contact. Except for the minute relative displacement near the point of contact, the balls move as a whole, every part having the same velocity at each instance of time and coming to rest at the same moment. In many cases of impact, however, and in those possessing the most interest from a practical point of view, this is by no means the case. We may consider, for instance, the impact of an elongated lead rifle bullet against a hard steel plate. Under the enormous pressures developed lead flows almost like water, and in the absence of lateral support it is as little capable of transmitting those pressures. Thus, when the nose of the bullet strikes, the metal thus brought into contact with the plate immediately flows out laterally, its forward motion being destroyed; but the hind parts of the bullet know nothing of what has happened to the nose, because the pressure cannot be transmitted to them, and they continue to travel on with the original velocity until they in their turn come up to the plate and have their momentum destroyed. The process of stopping the bullet is complete when its tail reaches the plate, and the time required is simply that taken by the bullet to travel its own length. Thus a Lee-Metford bullet is $1\frac{1}{4}$ inches in length, or, say, one-tenth of a foot, and if moving at 1800 feet per second, which is about the velocity given with a rifle, it would be stopped in 1/18,000 of a second. The bullet weighs approximately 0·03 lb., and possesses with this velocity about 1·7 lb. second units of momentum. The force required to destroy this in 1/18,000 of a second is 18,000 multiplied by 1·7 lb., or, say, 15 tons. This acts over the sectional area of the bullet, which is one-fourteenth of a square inch, giving a pressure of about 210 tons per square inch. This is the average pressure throughout the impact, but the pressure is probably nearly constant. It is to be noted that the pressure per square inch depends only upon the velocity (varying as its square), and not upon the length or diameter of the bullet. Increase in diameter only alters the area over which the pressure is applied, and increase in length the time during which it is applied.

If for the bullet of lead we substitute one of hardened steel which will not flow, the problem at once becomes much more complicated. In order to reduce it to its simplest terms, and to bring the theory into such a form that it can be tested in the laboratory, we may suppose that, instead of the bullet, we have a cylindrical steel rod, say $\frac{1}{2}$ inch in diameter by 10 inches long, with flat ends, and that it strikes quite fair against an absolutely unyielding surface. The latter condition could not be fulfilled in practice, because there is no substance more rigid than steel. So far as the effects on the rod are concerned, however, it can be fulfilled by making two rods, moving with equal velocities in opposite directions, collide end on; and this device has been used in the laboratory for imitating the effect of impact against an unyielding surface. We have to consider how long it takes to stop the rod under such conditions. When the end first strikes it is pulled up dead, just as in the case of the lead bullet, only it does not now flow out sideways. The pressure, however, set up at the end of the rod cannot be instantaneously transmitted through it, and consequently the hind parts do not at once feel this pressure, but continue to move on as before. The transmission of the pressure takes place with the velocity of sound, which for steel is about 17,000 feet per second, and it takes, accordingly, 1/20,000 part of a second before the pressure has been transmitted throughout the 10 inches length of the rod. A wave of pressure is initiated at the first contact and travels along the rod. At any instant the part of the rod which has already been traversed by the wave will be at rest and in compression, while the remainder which has not yet been reached by the wave, and accordingly as yet knows nothing of the impact, will still be moving forward with the old velocity. Each section continues to move on until the wave reaches it, when it is stopped with a jerk, the sections thus pulling up successively until the whole rod is at rest, which happens when the wave has travelled to the free end. From the momentum of the rod, and the time taken to stop it, the pressure can be calculated by the use of the principles already illustrated. Thus a rod 10 inches long is stopped, as we have seen, in 1/20,000 second, and if it be moving with the moderate velocity of 20 feet per second, the pressure required to pull it up in this time is 15 tons per square inch. This pressure is constant throughout the impact, and it is obvious that here again the intensity of pressure is dependent only upon the velocity, and not on the weight of the rod; for if with the same velocity the length is increased, the corresponding increase of momentum to be destroyed is cancelled by the greater time required for the transmission of the pressure wave, and if the area is increased the total pressure is merely increased in proportion, the pressure per unit area remaining the same. For a hard elastic body the pressure is proportional to the velocity, a principle which is probably generally applicable in the initial stage of all impacts.

At the instant of greatest compression, when the rod is reduced to rest, it is like a compressed spring, and there being no pressure acting at its free end to keep it compressed, it proceeds to expand again. Starting at the free end, a wave of expansion travels down the rod, the several portions being successively jerked into motion with approximately the original velocity. The whole process of restoring motion to the rod is completed when this wave reaches the impinging end, when the rod rebounds as a whole with the original velocity. The whole time of contact is, then, that taken by a wave of sound to travel twice the length of the rod. Here, again, by electrical measurement of the time of contact, it is possible to check the theory. It is found that the actual time is longer than that predicted. This is due to the fact that one cannot in practice make the rods hit absolutely true all over the ends; they strike at one point first, and the metal near that point has to be flattened out before the ends come into contact all over and initiate the simple plane pressure wave of the theory. The complete analysis of the discrepancies between theory and experiment so caused was long a puzzle to physicists interested in these matters. It was finally effected by Mr. J. E. Sears, who determined mathematically the corrections necessary on this account, and submitted his theory to experimental test with entirely satisfactory results.

Another simple instance of the propagation of waves along rods illustrates a point of importance in regard to the general effect of blows. Instead of maintaining the pressure during the whole passage of the wave up and down, as in the end-on impact, a pressure is suddenly applied to one end, maintained for a short time, and then removed. A corresponding pressure wave travels along the rod. Each portion of the rod is only stressed or in motion during the passage of the wave over it, and after the passage of the wave it is left with a certain forward displacement, but without any velocity or stress. Furthermore, the whole momentum of the blow is concentrated in the short length of the rod covered by the wave. On its arrival at the other end the wave is reflected, but the reflected wave is a wave of tension. As it comes back the head of the tension wave is at first wholly or partially neutralised by the tail of the pressure wave, but after a time it clears this, and the rod is then put into tension of amount equal to the original pressure. If there be a crack or weak place in the rod at a sufficient distance from the free end, the pressure wave will pass over it practically unchanged; but on the arrival of the reflected

tension wave the rod will part, because the crack cannot sustain the tension, and the forward part will move on, having trapped within it the whole momentum of the blow. The rest of the rod will remain at rest and unstrained.

(The propagation of waves in rods was illustrated by means of a model, consisting of horizontal wooden bars fixed at equal intervals to a vertical wire.)

The fact that a blow involving only pressure may, by the effects of wave action and reflection, give rise to tensions equal to or greater than the pressure applied, often produces curious effects which may be illustrated in many ways. I shall choose by way of illustration some observations which I have been making recently, and which I think are new. I have here a small cylinder of gun-cotton. By the use of a small quantity of fulminate in the hole provided for the purpose it is possible to detonate the gun-cotton, which means that in an excessively short time it is converted into gas at a very high temperature. The time required is probably only three or four millionths of a second, and is so excessively short that the gas does not during the process expand appreciably into the surrounding atmosphere.

Thus the gas generated, which, when completely expanded, will fill a space several thousand times as great, is for a minute fraction of time confined within the volume of this small fragment of gun-cotton. This confinement implies great pressure—how much is at present a matter of doubt. I understand that Sir Andrew Noble estimates it at 120 tons per square inch. The only thing which restrains the expansion of the gas is the inertia of the surrounding air, and the pressure accordingly drops with very great rapidity. It is probable that the pressure is practically gone after 1/25,000 of a second. The same pressure is, of course, exerted by the gas upon any surface with which gun-cotton is in contact, and it will be seen that the force so produced has the characteristics of a blow, namely, great intensity and short duration. If such a cylinder of gun-cotton weighing one or two ounces be placed in contact with a mild steel plate, the effect, if the plate be half an inch thick or less, will be simply to punch out a hole of approximately the same diameter as the gun-cotton, just as though it had been struck by a projectile of that diameter. But if the plate be three-quarters of an inch thick, the curious result which I exhibit here is obtained. Instead of a complete hole being made, a depression is formed on the gun-cotton side of the plate, while on the other a scab of metal of corresponding diameter is torn off and projected away with a velocity sufficient to enable it to penetrate a thick wooden plank, or to kill anyone who stands in its path. The velocity, in fact, corresponds to a large fraction of the whole momentum of the blow. The scab behaves much in the same way as the piece which we saw would be shot off the end of a rod struck at the other end if the rod were divided or weakened, so as to be unable to sustain the reflected tension wave. The separation of the metal implies, of course, a very large tension, which can only result from some kind of reflection of the original applied pressure; but the high velocity shows that this tension must have been preceded by pressure over the same surface, acting for a time sufficient to give its momentum to the scab.

Wishing to ascertain how and where the separation originates, I caused a two-ounce cylinder of gun-cotton to be detonated in contact with a somewhat thicker plate. In this case no separation of metal was visible, the only apparent effects being a dint on one side and a corresponding bulge on the other. On sawing the plate in half, however, I was gratified to find an internal crack, obviously the beginning of that separation which in the thinner plate was completed.

The pressure exerted by the gun-cotton in the experiments which I have just described is practically confined to the circular area of contact between it and the metal, as is shown by the accurate agreement of the print on the plate with that circle. The effects of that pressure must, however, be largely conditioned by the fact that the metal upon which it acts is attached to the surrounding portions of the plate, and is by them held back. In order to get an idea of the effect of this factor, I have tried the experiment of removing this outside metal, leaving the steel cylinder opposed to the gun-cotton. If such a short cylinder of steel be placed in contact with a gun-cotton cylinder of equal diameter, the result of detonation was at first sight merely to flatten it out slightly, and to produce a depression on one side with something of a bulge on the other. No external crack was visible. But on sawing the piece in half a remarkable system of cracks was disclosed; the cracks spread in all directions, as though tension had been acting in every direction; in fact, it appeared as though the steel cylinder had begun to burst. The tension necessary to produce these cracks, which, as you will see, must have radial as well as axial components, must originate in some kind of wave action which follows the blow. The problem is very complicated, and I have not yet succeeded in finding a full explanation of the phenomenon; but there cannot be much doubt that the longitudinal tensions are due to a wave generally similar to that which we have been discussing in connection with the rod. To account for the radial tensions which the cracks show also to have been present, it is to be observed that the shortening of the cylinder in the direction of its axis, which is the immediate effect of the blow, must be accompanied by a corresponding increase in diameter. This increase takes place very rapidly, and implies that at first the metal is moving out in a radial direction with a high velocity. The stoppage of this radial motion requires radial tension, and this probably is greater at points near the axis, for much the same reason that when a stone is dropped into a pond the circular waves which it causes have their greatest amplitude at points near the centre of disturbance. In the case of the steel cylinder the radial tension wave travels inwards from the surface, and its amplitude increases as it goes in.

I have recently been attempting to measure the duration of the pressures produced by the detonation of gun-cotton. The method depends on the reflection of a tension-wave at the free end of the rod. A wave of compression travels along the rod, the length of the wave corresponding to the time during which the pressure has acted; that is, it is equal to the velocity of sound multiplied by that time. We may assume that the time was 1/20,000 of a second, which would give a wave just 10 inches long. This wave travels to the end of the rod, is there reflected as a wave of tension, and comes back. If the rod be cut across, the surfaces of the junction being accurately faced and in firm contact, the pressure wave will pass the joint without change, but on the arrival of the head of the tension wave at the joint the parts will separate and the end piece will fly off. If the tail of the pressure wave has then cleared the joint, the separated end-piece will have trapped within it the whole momentum of the blow, and the part left behind will remain at rest and unstrained. In the case supposed things will happen in this way if the end-piece is more than 5 inches long. If it be less than 5 inches long, say 4 inches, there will, on the arrival of the reflected wave at the joint, be still 2 inches of pressure wave in the other part of the rod, and the corresponding quantity of momentum. In this case, therefore, only a portion of the whole momentum is trapped in the piece, the balance being left in the other part of the rod, which moves forward with the corresponding velocity. In order to discover how long the pressure lasts, it is only necessary to try a series of experiments with the joint at different distances from the free end. It will be found that if that distance exceeds a certain amount, the rod which was originally struck remains at rest, the whole momentum being transferred to the free end-piece. If the distance be less, only a fraction of the momentum is so transferred, and the balance remains in the struck rod, which accordingly moves forward. By trying a series of experiments with end-pieces of different lengths, the rate at which the pressure disappears can be determined. In this way I have shown that the pressure developed by the detonation of 0·1 ounce of gun-cotton is practically all gone in 1/30,000 of a second.

I have on the table some specimens to show the effects of detonating larger quantities of gun-cotton. Here is a steel plate which has been broken by firing a charge of about 1 lb. in contact with it. It is interesting to note the character the fracture produced. This plate is a good quality of mild steel, such as is used for making boilers. It would be possible by a steadily applied pressure to bend

it double without fracture, yet as the effect of the blow delivered by the gun-cotton it is broken with very little bending, almost as though it were cast iron or very hard steel. Time will not permit of my going further into the interesting question—of course a very important one in connection with our subject—of the effect on the character of the fracture produced of very big stresses lasting for a very short time. This case of the fracture of mild steel by gun-cotton shows, however, that one result may be that the property of ductility largely disappears under the action of a sufficiently violent blow. The mild steel, in fact, behaves very much like sealing-wax or pitch. The stick of sealing-wax which I hold in my hand has been bent by the continued action of a small force acting for several days, and the same force, had it continued to act, would ultimately have bent it double without breaking it. Yet under the application of a force many times as great it snaps like a piece of glass.

The pressures produced by the detonation of gun-cotton are of the same order of intensity as those developed in ordinary blows. We saw that in the impact of billiard balls the average pressure over the area of contact may reach a value of 27 tons per square inch, and with steel balls moving at quite small velocities, such as 2 or 3 feet per second, it is easy to get pressures of 100 tons per square inch or more. These pressures, however, are very local, the area over which they act being a few hundredths of an inch in diameter only. By means of gun-cotton similar pressures may be applied over any desired area, but the intensity is no greater. About 120 tons per square inch is probably the limit of simple static gaseous pressures produced by known practical explosives. Probably greater pressures are produced with fulminate, but that cannot be used except on a very small scale. For the production of destructive effects on hard steel greater pressures than this are required, and in order to develop them on any considerable scale we must again have recourse to the dynamic action of collision.

We have already seen that a lead bullet moving at 1800 feet per second probably generates a pressure of 200 tons per square inch or more. We went on to consider the impact of rods of hard metal, and it appeared that two rods of steel colliding end on with a relative velocity of 40 feet per second would develop a pressure of about 15 tons per square inch over the whole section of either. The theory on which that conclusion is based has been subjected to experimental test—indirect, it is true, but sufficiently searching—and is certainly correct for velocities and pressures of that order. According to the theory, the pressure is simply proportional to the relative velocity of the two rods, so that if they collided at 2000 feet per second, that is, fifty times as fast, the pressure would be 750 tons per square inch, assuming that the theory continues to hold under these very different conditions.

One of the fundamental assumptions on which the theory is based, however, would certainly break down long before such a velocity was reached. That assumption is that the pressure leaves no permanent effect on the material. I do not know what is the strongest steel for this purpose which has been produced, but I think it may safely be asserted that no known substance would stand an end compression, such as results from the blow of the colliding rods, of more than 300 tons per square inch. If it were ductile it would flow so rapidly under this pressure that there would be appreciable deformation even in the very short time during which the pressure lasts. If it were very hard it would be instantly shattered. In both cases the circumstances of pressure transmission would be completely altered. It is, however, fairly certain that in neither would the pressure exceed that calculated on the hypothesis of perfect elasticity, and that in both it would be greater than that calculated (as for the lead rifle bullet) on the hypothesis of no elasticity.

I am afraid, therefore, that at present our theories can throw but little light on the interesting question of the pressure developed when a hard steel armour-piercing shell strikes a hard steel plate with a velocity of 2000 feet per second. But a consideration of the visible effects of such a blow is suggestive in many ways, and by the kindness of Sir R. Hadfield I am able to describe and show some of them to you to-night.

You see before you specimens of modern armour-piercing shot. The shell is made of a special steel of great strength and considerable ductility, and after manufacture the point is hardened by thermal treatment, the base and most of the body of the shell remaining more or less ductile. In recent years it has become the practice to fit a cap of soft steel over the hardened point. I will speak of the functions of this cap later, and for the present we will consider the shell without it.

I first show the effect of firing an uncapped shell at a plate of wrought iron or mild steel. In this case the metal of the plate is so soft that pressures that are quite without effect on the hardened point of the shell are able to make it flow very rapidly. The shell simply ploughs its way through, pushing out the wrought iron before it, and emerges quite unscathed. It will be noticed that on the striking side there is a rim or lip of wrought iron which has been squeezed out in a direction opposite to the movement of the shell. A similar lip is formed if a hole is blown in a lead plate by means of a gun-cotton primer, and there seems to be a good deal of analogy between the two cases.

Completely to stop a 14-inch shell, such as that which you see before you, would require a thickness of at least 2½ feet of wrought iron, and almost as great a thickness of mild steel. I believe that some ships twenty-five years ago were fitted with armour of this sort of thickness, but, of course, the weight is almost prohibitive. Modern improvements in armour, whereby the same effective resistance is obtained with less than half the thickness, are based on the use of special steel having sufficient ductility to enable it to be worked and fixed in place on the ship, while possessing greater strength than wrought iron or ordinary structural steel. Even such a special steel, however, is handicapped as against the shell by the hard point of the latter, which is able to force the softer material aside, though itself undamaged. This disability, however, has been overcome by hardening the face of the plate, so that it now possesses a composite structure, the back being tough and ductile, but the face as hard as it is possible to make it. When such a plate is struck by the shell it is a case of Greek meeting Greek, and this is the result (photograph). Both the shell and the hardened face of the plate are shattered by the pressure, sufficient of which is transmitted through the substance of the plate to crack it right through, though, of course, none of the shell has penetrated it.

It would seem that when it acquired the hard face the armour plate more than overtook the shell in the race. Though the shell might by sheer energy pierce a somewhat thinner plate, I am told that it was apt to be smashed to pieces in the process. The balance has of recent years been more than restored by the addition to the shell of the soft steel cap. I have already shown you the effect of firing an uncapped shell; I will now direct your attention to that of firing the same shell with cap at the same plate. The shell goes through minus its cap, but otherwise so completely uninjured that I am told it might in many cases be used again. It punches a clean hole in the plate. The fate of the cap is interesting. The shell punches a hole in it, as of course it must do before it reaches the plate, and the cap forms a ring, which is held up by the plate, and through which the shell passes. The fragments of the cap are found on the front side of the plate, and in some instances they have been collected and put together, forming a ring. I have one such ring here. Its largest diameter is that of the shell, its smallest about an inch less, and it looks as though the ring had got intact as far as the shoulder of the projectile, but had then burst into several pieces.

The usual explanation of this remarkable effect of a soft steel cap is that it supports the point of the projectile. As I pointed out in connection with billiard balls, the destructive effect of pressure depends on the difference of pressures in different directions, and not on their absolute amounts, and it is obvious that by the exercise of a sufficient lateral pressure the point might be completely protected. The difficulty is to see how the comparatively weak material of which the cap is made can exert the very large pressures which are necessary for effective support. It seems hardly possible that such pressures could be

generated by the mere act of stretching or expanding the cap over the end of the shell. If this be so, the inertia of the metal in the cap must play an important part. At the critical moment when the hard point of the shell meets the plate, there is a sudden distortion of the shell and plate near the point of contact. This distortion is the cause of breakage. One can see that the mass of mild steel surrounding the point of the shell, and pressed into firm contact with it, might by its inertia oppose a powerful resistance to this sudden change of form, and so support the shell during the minute fraction of time which determines whether it or the plate shall go.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the last meeting of the City Council the recommendation of the Education Committee to allot to the University the proceeds of a penny rate was discussed. The amount which would have been raised by such a rate is about 16,000*l*. at present, and would increase with the growth of the city. Some opposition to the recommendation was made by the supporters of the Birmingham and Midland Institute, who wished 1000*l*. per annum to be granted to that institution. Further opposition came from some of the Socialist members of the Council on the ground that the money would be better spent in increasing the facilities for secondary education to the poorer classes. A letter was read from the Board of Education pointing out that the ear-marking of so large a sum as that required by the Education Committee for additional scholarships would materially lessen the value of the grant to the University for the purpose of diminishing its present debt, and this would be taken into consideration in allotting the Treasury grant, which was to be allocated to the various applicants in proportion to the amount of local support forthcoming. The result of the discussion was the assigning of a sum of 15,000*l*. per annum from April 1 until further notice.

The annual reports of the University Council and Principal have been published, from which it appears that the total number of registered students during the past session was 1017, as against 958 for the previous session. The Principal again emphasised the need for a chair of Greek. He also hoped that some further development in facilities for agricultural studies would be made during the present session.

Prof. John Joly, F.R.S., has been appointed Huxley lecturer for the current session.

OXFORD.—The following letter has been addressed to the Vice-Chancellor by Prof. Karl Pearson, F.R.S. :—

"Dear Mr. Vice-Chancellor,

"I feel very deeply indeed the honour which has been conferred on me by the award of the Weldon Prize. I realise fully also the difficulties under which the Electors have been placed owing to the terms of the statutes. But as one who was partly instrumental in founding the prize, and who also had many opportunities of knowing the views held with regard to such prizes by the man whose work it commemorates, will you allow me to be at once very grateful for the award and yet to ask the University to pass me over in its selection?

"I feel strongly that, whatever the formal wording of the statutes may be, the intention of the donors and the spirit of the late Prof. Weldon, which influenced their foundation, was the encouragement of younger men, to whom timely recognition may mean an all-important indication that their work is appreciated and their chosen path a fitting one.

"KARL PEARSON."

DR. A. H. FISON has been appointed secretary of the Gilchrist Educational Trust, in succession to the late Dr. R. D. Roberts.

MR. ALFRED SCHWARTZ has resigned the professorship of electrical engineering in the Manchester University and the School of Technology on his appointment by the President of the Board of Education to a staff inspectorship in engineering under the Board. The resignation dates from March 31.

THE issue for January of *The Technical Journal*—the organ of the Association of Teachers in Technical Institutions—is full of material of interest to the members of the association and others engaged in technical education. Among the most noteworthy contributions may be mentioned the statement of the evidence given by the Association of Teachers in Technical Institutions before the Royal Commission on University Education in London, and the presidential address of Mr. Barker North at the annual meeting of the association last November. A portrait is included of Mr. J. H. Reynolds, whose retirement from the principalship of the Manchester Municipal School of Technology will take place shortly.

IT is announced in *Science* that the directors of Bryn Mawr College have formally accepted the bequest of 125,000*l*. made by the will of the late Emma C. Woerishoffer, of New York, who was killed in an automobile accident last summer. The whole sum has been constituted as a permanent endowment fund. From the same source we learn that the sum of 10,000*l*. has been given to Beloit College by Mrs. Rufus H. Sage, of Chicago. The total endowment of this college—in interest-bearing securities—is now increased to 250,000*l*., in addition to the value of the buildings. A third gift, reported in the same issue of our contemporary, is that of Mr. Robert W. Sayles, in charge of the geological section of the Harvard University Museum, who has given the sum of 1000*l*. to the Seismological Society of America, to aid in the publication of the society's Bulletin.

THE Child Study Society of London announces that a conference of combined societies will be held in the University of London on May 9 to 11 next under the presidency of Sir James Crichton Browne, F.R.S. The subject for discussion at the conference will be "The Health of the Child in relation to its Mental and Physical Development." Papers will be contributed to introduce discussions on the "Influence of Defects of Hearing, and of Vision, in relation to the Mental and Physical Development of the Child," by Dr. J. Kerr Love and Mr. N. Bishop Harman; "The Tuberculous Child," by Dr. Jane Walker; "Mental Hygiene in relation to the Development of the Child," by Dr. Theo Hyslop; and "Instruction of the Young in Sexual Hygiene," by Dr. G. Eric Pritchard. A lecture to the conference on "Eugenics and Child-study" will be delivered by Dr. C. W. Saleeby.

THE council of Bedford College has announced that the 100,000*l*. required to erect the new buildings at Regent's Park and to inaugurate an endowment fund has now been obtained. As has been recorded in these columns, 50,000*l*. had been raised by the beginning of November last for the building fund, 20,000*l*. of it being promised by the London County Council, who also promised 10,000*l*. more if the college could raise a similar sum immediately. By the end of last year the college raised the amount named, and secured the further grant. We learn from *The Times* that the council has now been informed by Lord Haldane, president of the building and endowment fund, that he has received from a donor who desires at present to withhold his name the promise of 30,000*l*. towards the fund. Simultaneously with this donation comes the promise from another anonymous donor of 10,000*l*. for the erection of a hall and common rooms, while the Worshipful Company of Goldsmiths has granted 5000*l*. towards an endowment fund.

THE International Commission on Mathematical Education will meet at Cambridge on August 22–28, on the occasion of the fifth International Congress of Mathematicians. It will be remembered that the commission owes its existence to a resolution of the Rome Congress of 1908. The educational subjects proposed for discussion are the following :—(1) intuition and experiment in mathematical teaching at secondary schools, in particular, the use of drawing, measurement, and calculation (numerical

and graphical) in the upper classes of schools that prepare for the universities; (2) mathematics as needed in the study of physics. In preparation for these discussions, information is being collected as to the conditions prevailing in different countries. The information collected will be published in *L'Enseignement Mathématique* (Paris: Gauthier-Villars); and as regards the position of (1) in this country, a report in greater detail will be published by the Board of Education. The meetings and other proceedings at Cambridge will be open to all who pay the subscription of a guinea.

THE annual report of the council of the Institution of Mechanical Engineers includes as an appendix a draft scheme for associate membership examinations. Just as the Institution of Civil Engineers and the Surveyors' Institution have found it expedient to hold similar examinations, the council of the Institution of Mechanical Engineers is of opinion that the time has come for instituting an entrance examination for the younger applicants for admission to its institution. The council suggests (1) that the examination should be taken, especially by graduates, at as early an age as possible, and in order to bring such a scheme gradually into operation it might be desirable that it should apply in the first year only to candidates of twenty-eight years of age and under, in the second year to candidates of twenty-nine years of age and under, and in the third and subsequent years to candidates of thirty years of age and under; (2) that no examinations need be held abroad at present; (3) that, so far as possible, examinations of universities and colleges or other public examining bodies should be accepted as exempting from the institution examination, it being understood that only such examinations as are of at least a standard equal to the institution examination will be accepted. A list of examinations which might be accepted as exempting candidates is provided, and it may be noted this list includes the engineering degrees of British universities, the diplomas of the City and Guilds College, University College and King's College, London, and Whitworth scholarships and exhibitions. The suggested subjects of examination are grouped under general, scientific, and technical knowledge.

THE standing committee, of which Sir Matthew Nathan is chairman, dealing with the employment of boy labour in the Post Office, has issued its second report. In the first report, published last year, a number of recommendations were made, which have been acted upon. A scheme of education for the boys, designed to improve their qualifications and to fit them for further employment, has been approved by the Postmaster-General. The number of boy messengers was reduced from 15,790 in March, 1911, to 14,506 in September, 1911. Instead of there being only 1900 vacancies per year in the Post Office service for these boys to fill later, a revised estimate gives the number as 2350, of which 1280 are for postmen. The Navy and the Royal Engineers can also take some of the boys for special service. The report deals also with the boys' training for subsequent employments. A useful purpose is served by the boys' institutes, which are carried on mainly by the voluntary work of local officials, and receive grants amounting to 200*l*. a year from the Treasury. The evening schools of local education authorities also have been made use of, half the boys' fees being paid out of institute funds. The number of boys who attended classes during the session 1910–11 in London and seventy-eight provincial towns was 6479, or about 70 per cent. of the whole number employed in those towns. To remedy irregular attendance, which has been somewhat pronounced, the committee recommended compulsory attendance at the classes, and a minimum of four hours a week, from September to April, was fixed, this being made a condition of employment during the boys' first two years of service. Special classes for the boys are recommended, and an essential feature is that the boys' attendances are to be arranged so that each class should always be composed of the same boys. The committee approached the Postmaster-General with these recommendations, and he approved of their being carried out without delay. The committee has come to the conclusion that the basis for permanent employment shall be a competitive examination in the subjects taught at the compulsory classes.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 8.—Sir Archibald Geikie, K.C.B., president, followed by Sir Alfred Kempe, vice-president and treasurer, in the chair.—Sir Norman **Lockyer**: The spectrum of comet Brooks (1911*c*). In this paper an account is given of the lines shown in a series of ten photographs of the spectrum of comet Brooks, taken between September 6 and October 31. Seven of the photographs were taken while the comet was an evening object, and three when it was a morning object. The instrument used was a 2-in. quartz-calcite prismatic camera. In the best spectrum (September 30), in addition to the well-established carbon or carbon-compound bands at λλ 3883, 4737, 5165, 5635, other radiations were seen at λλ 310, 316, 337, 405, 421, and 436. Line λ 421 is probably the cyanogen band, the head of which is λ 4216. So far as is known, the ultra-violet bands λλ 310, 316, 337 have not been recorded in the spectrum of any previous comet. Attempts have been made to ascertain the chemical origin of these lines by reference to published records of laboratory spectra, and to recent photographs of the spectrum of CO taken with the quartz-calcite prism, but with no success. Although no definite changes in the relative intensity of the cometary lines were noted amongst the earlier photographs, a comparison of the best of these (September 30) with that of October 31, when the comet was a morning object, showed the following changes:—(1) On September 30 line λ 4216 was weakest of the three subsidiary lines λλ 405, 4216, 436. On October 31 it was strongest. (2) Lines λλ 3883, 4737 were of about equal intensity on September 30. On October 31 λ 3883 was distinctly the stronger. (3) The ultra-violet lines λλ 310, 316, 337, shown in the spectrum of September 30, were not seen on October 31. A photographic comparison is given of the Kensington spectrum of comet Brooks (September 30) with that of comet Daniel (1911*d*), reproduced by Campbell in Lick Bulletin No. 135. Although the latter showed far more detail, being photographed with a slit spectrograph, it is fairly evident that the spectra of the two comets are very similar.—Hon. R. J. **Strutt**: A chemically active modification of nitrogen, produced by the electric discharge.—III. (1) Active nitrogen emits its energy more quickly, and reverts sooner to ordinary nitrogen, if it is cooled. This is apparently a unique instance of a chemical change accelerated by cooling. (2) If the glowing gas is compressed to small volume, it flashes out with great brilliance, and exhausts itself in so doing. This proves that the glow-transformation is polymolecular, *i.e.* that more than one molecule must take part in it. (3) Active nitrogen may revert to ordinary nitrogen in two distinct ways. One of those is a volume change, accompanied by glow; the other a surface action of the walls of the vessel, without glow. This is analogous to the behaviour of oxyhydrogen gas in its transformation to water, which may be a surface or volume effect, according to circumstances.—R. **Whytlaw-Gray** and Sir W. **Ramsay**: The atomic weight of radium. The material for this research consisted of 330 mg. of a mixture of radium and barium bromides, containing 200 mg. of radium bromide, supplied by the courtesy of the British Radium Corporation. The bromides were submitted to methodical fractional crystallisation, and yielded specimens of which the change in weight on conversion from bromide to chloride with gaseous hydrogen chloride, and from chloride to bromide with gaseous hydrogen bromide, was determined with the micro-balance. The atomic weight increased progressively from 220·7, through a series of approximations, to the final atomic weight 226·36, the last five determinations giving the figures 226·40, 226·25, 226·35, 226·35, and 226·45. The paper contains remarks on the differences in terms of multiples of the atomic weight of helium between the recorded determinations of the atomic weight of uranium and radium on the one hand, and of radium and lead on the other, and it is pointed out that a careful revision of the atomic weights of lead and of uranium, especially of the latter, is much to be desired.—Dr. J. A. **Harker** and Dr. G. W. C. **Kaye**: The emission of electricity from carbon at high temperatures. This paper discusses several new phenomena, among which are the generation of electric

currents of considerable magnitude by what appears to be a new method. Two insulated carbon electrodes are inserted into a carbon tube resistance furnace at high temperatures, and are connected externally through a suitable current-measurer. If one of the electrodes is suddenly displaced to a colder or hotter part of the furnace, a reversible transient current is produced in the circuit without the application of any external potential. By such means, currents up to 2 amperes have been obtained. The production of an alternating current is thus rendered possible by the use of a suitable periodic device. A continuous current can be generated by suitably modifying the apparatus so as to maintain a large permanent temperature-difference between the electrodes. A steady current of 0·8 ampere has been thus obtained for a few minutes, and 0·1 ampere for more than an hour by water-cooling one electrode. These currents are such as would be produced by a discharge of negative particles from the hot electrode. At the lower temperatures positive currents have also been detected, but of much smaller magnitude. All the observations were made at atmospheric pressure. The extent of the ionisation of the furnace atmosphere at high temperatures was such that quite small E.M.F.'s, applied to two exploring electrodes, gave rise to steady currents of relatively enormous magnitude. For example, with 8 volts, currents up to 10 amperes have been obtained at a temperature of about 2500° C. Some of these observations have been repeated with furnaces of a non-electric character.—Prof. H. T. **Barnes**: The so-called thermoid effect and the question of superheating of a platinum-silver resistance used in continuous-flow calorimetry.—Prof. E. G. **Coker**: An optical determination of the variation of stress in a thin rectangular plate subjected to shear. The distribution of stress in a rectangular plate subjected to shear is examined by observing the optical effects in polarised light produced in a stressed plate of xylonite. Measurements of the shear stress at a point are obtained by using a specimen of material similar to the plate, and set along the direction of principal compression stress. A tension load is applied to this member of sufficient amount to produce a dark field at the point under examination. The intensity of tension stress so produced is twice the density of the shear stress in the plate. A survey of the central longitudinal section of a long rectangular plate shows that the shear stress rises very rapidly from a zero value at the ends, and reaches a maximum at a distance of rather less than the face width of the plate. As the distance from the ends increases, the stress decreases slightly in value until it reaches a minimum at the centre. A similar distribution also occurs at sections parallel to the central line. As the length of the plate is diminished the maximum and minimum stresses become more pronounced, and when the ratio of length to width is in the neighbourhood of two, the distribution changes in such a manner that there is a maximum at the centre. It is shown that the distribution is approximately parabolic when the length is equal to the width of the plate, and that when the length is greater than this the approximation is less close. The experiments show that a parabolic distribution of shear is only true within narrow limits, and that in a long rectangular section the distribution may be approximately represented by a uniform shear over the central section with a rapid fall towards the ends.—Dr. P. V. **Bevan**: Spectroscopic observations: lithium and cæsium. —Captain C. F. U. **Meek**: A metrical analysis of chromosome complexes, showing correlation between evolutionary development and chromatin thread-widths throughout the animal kingdom. Measurements of chromosomes in organisms representing the principal phyla and classes of the animal kingdom have shown that lengths appear to constitute members of a series in arithmetical progression, whereas three distinct diameters exist, viz. 0·21 μ in Protozoa, and 0·42 μ and 0·83 μ in low and higher metazoan phyla respectively. Consideration of these results has suggested the following working hypothesis:—The chromatin granules of simplest Protozoa are a visible expression of differentiation and aggregation of specialised particles concerned with transmission of hereditary characters, and as such probably do not represent the sole bearers of heredity in the cell. The granules become converted into rods by purely linear growth accompanying evolutionary development and greater somatic complexity, and, since the rate of growth is not the same in all chromosomes, rods of various lengths are evolved. A stage in phylogeny is later reached when a maximum rod length has been attained, such limit being imposed by spindle mechanism or other physical conditions; when this occurs, chromatin units conjugate in fours, and the normal thread-width is thus doubled. The newly formed chromosomes then segment into spheres of the same diameter, and these are prepared to enter a new course of linear growth accompanying further development. The same process is repeated when the length-limit has again been reached, and in this manner the greatest thread-width has evolved. The absence of correlation between chromosome dimensions and somatic characters is explicable on such an assumption, which postulates a series of cycles in the course of phylogeny. The heterotropic chromosome alone does not belong to the general series, and its great breadth may eventually be shown to be due to conjugation of normal rods; it is probably undergoing some process of development or disintegration, and may or may not be the determining factor in sex.

Linnean Society, February 1.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—Fauna of the Seychelles and other islands of the Indian Ocean. (1) A. **Forel**: Fourmis des Seychelles et des Aldabras, reçues de M. Hugh Scott. (2) F. W. **Edwards**: Tipulidæ. (3) Dr. Günther **Enderlein**: Sciaridæ. (4) Claude **Morley**: The Ichneumonidæ. (5) C. Tate **Regan**: New fishes.

Mathematical Society, February 8.—Dr. H. F. Baker, F.R.S., president, in the chair.—A. C. **Dixon**: Exceptions to extensions of a theorem of Jacobi's.—W. **Burnside**: Some properties of groups whose orders are powers of primes.—G. H. **Hardy** and J. E. **Littlewood**: Some results concerning diophantine approximations.

Malacological Society, February 9.—R. Bullen **Newton**: *Presidential address*: "On the Lower Tertiary Mollusca of the Fayum Province of Egypt." The president referred to the discussion among writers on vertebrate palæontology as to the age of the Palæomastodon beds occurring near the base of the Jebel el Qatrani deposits in the north of the Fayum depression of Egypt. Such beds were regarded by Mr. Beadnell and Dr. C. W. Andrews as Bartonian, whereas Prof. Depéret and others had assigned them to the Sannoisian-Stampian division of the Oligocene period. Instead of regarding them as younger, Mr. Newton was of opinion that they might even be older, and he was much in favour of recognising the beds as belonging to the Lutetian-Bartonian stage of the Eocene, since the associated genera Mœritherium, Podocnemis, and Stereogenys occurred alike in these beds as well as in the Qasr el Sagha deposits below, which are undoubtedly of Lutetian or Middle Eocene age. Certain estuarine Mollusca, particularly *Potamides scalaroides* and *P. tristriatus*, occurred high up in the Jebel el Qatrani section and some 150 metres above the Palæomastodon bed; these gastropods have been determined by Dr. Blanckenhorn as indicative of the Bartonian horizon, and are therefore conclusively against the view that the vertebrates belong to the younger period of the Oligocene. Mr. Newton supported these molluscan determinations, and, moreover, upheld Dr. Blanckenhorn's opinion that the species were characteristic of the "Beauchamp Sands" of the Paris Basin, and consequently belonged to the older part of the Bartonian horizon.

PARIS.

Academy of Sciences, January 29.—M. Lippmann in the chair.—The president read a letter from Prince Roland Bonaparte giving a donation of 35,000 francs to the French School of Medicine at Beyrout.—G. **Bigourdan**: An unpublished work of Delambre, "Grandeur et figure de la Terre."—A. **Lacroix**: Lavas from the active volcano of Reunion. Complete chemical analyses are given of thirteen lavas, and a discussion of the results.—Ch. **André**: The total eclipse of the moon of November 16, 1910. The positions of three uncatalogued stars, referred to in the author's previous note on the eclipse, are given. —Hildebrand Hildebrandsson was elected a correspondant for the section of geography and navigation in the place

of the late M. Davidson.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1911. Observations were made on seventy-four days, the results being summarised in three tables.—Henri **Bénard**: The formation of lunar craters according to the experiments of C. Dauzère. A reproduction is given of a photograph by C. Dauzère showing the appearance of a surface of beeswax after solidification, and the bearing of this upon the author's theory of the causes of lunar relief is discussed.—G. **Pick**: Parallel lines and translation, and differential geometry in non-Euclidean space. The results published by the author in a recent paper in the *Comptes rendus* were obtained by M. Fubini in 1900. —J. E. **Littlewood**: Some consequences of the hypothesis that the function $\zeta(s)$ of Riemann has no zero in the demi-plane $R(s)>\frac{1}{2}$.—G. **Cotty**: A class of quadratic forms with four variables connected with the transformation of Abelian functions.—J. **Tamarkine**: The problem of the transversal vibrations of a heterogeneous elastic rod.—Louis **Chaumont**: The construction and verification of a quarter-wave plate of mica.—Emmanuel **Legrand**: Testing metallic lamp filaments for resistance to shock. A detailed description of the testing apparatus is given.—Georges **Meslin**: The application of wireless telegraphy to the measurement of coefficients of self-induction. The method is distinguished from those in ordinary use in that it reduces to a length measurement a quantity (self-induction) which has the dimensions of a length.—Albert **Colson**: The theory of solutions compared with experiment. The case of nitrogen peroxide. The author regards the identification of the dissolved particle with the gaseous molecule as not proven, and considers the thermal changes actually occurring during the process of solution disprove the van't Hoff theory. Experimental determinations by a new method of the partial pressures on NO_2 and N_2O_4 are given.—M. **Barre**: Some double carbonates of calcium. A description of the carbonates

$$CaCO_3.Na_2CO_3.2H_2O \text{ and } CaCO_3.K_2CO_3,$$

and a study of the conditions under which they are formed. —E. **Léger**: The constitution of chrysophanic acid. This acid is shown to be dioxy-1:8-methyl-3-anthraquinone.—A. **Mouneyrat**: The toxicity of the compounds of arsenic employed in therapeutics. For equal weights of the arsenic compound, the danger is greater the shorter the time between successive injections. The experiments were carried out on rabbits, and it was found that the animals showed varying degrees of tolerance to the drug.—A. **Guilliermond**: The leucoplasts of *Phajus grandifolius* and their identification with mitochondria.—François **Kövessi**: The influence of electricity (direct current) on the development of plants. The experiments were chiefly carried out with wheat, and show that the current is harmful to the germination of the seed and to the development of the plant.—Marin **Molliard**: Is humus a direct source of carbon for the higher green plants? If humus can be assimilated directly by green plants, it must be in very small proportions.—Louis **Ammann**: A comparison of the results obtained by maceration and diffusion in beetroot distilleries in agricultural centres. Both methods extract the sugar equally well; the maceration process requires less skilled supervision than the diffusion process, but the latter has the advantages of rapidity and of requiring less liquid.—A. **Marie** and Léon **MacAuliffe**: The morphology of French assassins, suicides, and murderers.—Marcel **Baudouin**: The wear of the teeth of the first and second dentition of men of the Neolithic period is due to earth-eating.—L. A. **Pelous**: The relations between the phenomena of osmosis and the electric discharge. The osmotic pressure is increased by the silent discharge.—A. **Magnan**: The surface of the intestine in mammals.—A. **Comte**: Variation in the moths of *Bombyx mori*.—M. **Trabut**: A disease of the date palm, khamedj, or rotting of the fruit bunch. The disease is due to a parasite, identified as *Phoenicococcus marlatti*.

MELBOURNE.

Royal Society of Victoria, December 14, 1911.—Prof. E. W. Skeats in the chair.—Olive B. **Davies**: The anatomy of the slug *Cystopelta petterdi*, var. *purpurea*. The structure was examined by dissections and by serial sections.—Janet W. **Raff**: Protozoa parasitic in the large intestine of Australian frogs, part ii. *Opalina tenius*, *O. dorsalis*, *O. acuta*, *Entamoeba morula* are described as new.—R. J. A. **Berry** and A. W. D. **Robertson**: Dioptrographic tracings in three normæ of ninety Australian aboriginal crania.—W. **Lowe**: The tropics and pigment. Pigment prevents the entrance of actinic rays, transforms them to heat, which indirectly stimulates the sweat glands and is dissipated.—N. **Macdonald**: Machine-drawn *versus* hand-drawn milk. With proper precautions as to cleanliness, the machine does no harm either to the milk or the cow.—A. J. **Ewart**: Bitter pit and the sensitivity of apples to poison. Ripe pulp cells of apples are extremely sensitive to poison. One part in ten thousand million of mercuric chloride is toxic. Poison can enter the sound fruit only by the breathing pores, and on doing so will produce bitter pit. Copper and lead are less poisonous than mercury. The poisonous action of copper sulphate and other similar metallic salts may be decreased by adding substances which decrease the percentage of free ions. Fungicides will kill the apple long before they kill the fungus.—J. A. **Gilruth** and L. B. **Bull**: Enteritis associated with infection of the intestinal wall by cyst-forming protozoa (Neosporidia) occurring in certain native animals (wallaby, kangaroo, and wombat). Wallaby, *Sarcocystis macropodi*, situated in submucosa; kangaroo, *Ileocystis macropodi*, situated in mucosa, apparently an epithelial infection, and *Lymphocystis macropodi*, apparently a mononuclear infection; wombat, *Ileocystis wombati*, epithelial infection.—K. A. **Mickle**: Flotation of minerals, part ii. Oil attachments. Sulphides adsorb oil more readily than does gangue in acid solutions. Finely divided sulphides in acidulated water attach the oil to form only plastic magma. After this additional oil attachments are unstable; with less oil, less coherent magma is formed, practically non-coherent with 0·1 per cent. oil. Gas attachments. Gas collected from finely divided dry sulphides *in vacuo* found to be CO_2 with smaller amounts N and O. This is probably present as adsorbed film. Gas collected from flotation product *in vacuo* consists of CO_2 with varying amounts N and O. Gas disengaged from flotation scum on bubbles bursting is found to consist of CO_2 and nitrogen, with smaller amounts of oxygen.

BOOKS RECEIVED.

Four Place Tables of Logarithms and Trigonometric Functions. Compiled by E. V. Huntington. Unabridged edition. Pp. 33. (Cambridge, Mass.: Haward Co-operative Society; London: E. and F. N. Spon, Ltd.) 3*s*. net.

Cambridge County Geographies:—Midlothian. By A. McCallum. Pp. x+208+maps. Buckinghamshire. By Dr. A. M. Davies. Pp. xii+222+maps. Northamptonshire. By M. W. Brown. Pp. xii+225+maps. (Cambridge: University Press.) 1*s*. 6*d*. each.

Earth and her Children. By H. M. Livens. Pp. 248. (London: T. Fisher Unwin.) 5*s*. net.

The British Bird Book. Edited by F. B. Kirkman. Section VII. Pp. 194+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10*s*. 6*d*. net.

Irises. By W. R. Dykes. Pp. xiv+110+8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack.) 1*s*. 6*d*. net.

Prehistoric Parables. By W. Bell. Pp. vii+63. (Halifax: Milner and Co.) 1*s*. net.

Electro-analysis. By Prof. E. F. Smith. Fifth edition. Pp. xi+332. (London: Kegan Paul and Co., Ltd.) 10*s*. 6*d*. net.

Waves and Ripples in Water, Air, and Æther. By Prof. J. A. Fleming, F.R.S. Second edition. Pp. xii+299. (London: S.P.C.K.) 2*s*. 6*d*. net.

The Forest Trees of Britain. By the late Rev. C. A. Johns. Tenth edition. Revised by G. S. Boulger. Pp. xiv+431. (London: S.P.C.K.) 6*s*. net.

University of London. Francis Galton Laboratory for National Eugenics. Eugenics Laboratory Memoirs. XV. Treasury of Human Inheritance. Parts vii. and viii. Section XV. A: Dwarfism, by Dr. H. Rischbieth and A. Barrington. Pp. xi + 355–573 + Plates li.–lviii. + O–Z + A.A.–W.W. (London: Dulau and Co., Ltd.) 15*s*. net.

The Migration of Birds. By T. A. Coward. Pp. ix+137. Prehistoric Man. By Dr. W. L. H. Duckworth.

Pp. viii+156. The Natural History of Clay. By A. B. Searle. Pp. viii+176. The Modern Locomotive. By C. E. Allen. Pp. ix+174. Earthworms and their Allies. By F. E. Beddard, F.R.S. Pp. vii+150. (Cambridge Manuals of Science and Literature.) (Cambridge: University Press.) 1s. net each.

Micropetrology for Beginners. By J. E. W. Rhodes. Pp. xv+126. (London: Longmans and Co.) 2s. 6d. net.

National Insurance. By A. S. Comyns Carr, W. H. S. Garnett, and J. H. Taylor, with a Preface by the Rt. Hon. D. Lloyd George, M.P. Pp. xxx+504. (London: Macmillan and Co., Ltd.) 6s. net.

Siam: a Handbook of Practical, Commercial, and Political Information. By A. W. Graham. Pp. xvi+637. (London: A. Moring, Ltd.) 10s. 6d. net.

Lessons in Geometry. By Dr. C. McLeod. Part i. Pp. xii+212. (Aberdeen: University Press.) 2s. 6d. net.

La Pila Elettrica. By A. Astolfoni. Pp. xv+297. (Milan: U. Hoepli.) 3 lira.

On the Mesozoic Rocks in some of the Coal Explorations in Kent (Memoirs of the Geological Survey, England and Wales). By G. W. Lamplugh, F.R.S., and Dr. F. L. Kitchin. Pp. vi+212. (London: H.M. Stationery Office; E. Stanford, and others.) 3s. 6d.

Wimbledon Common, its Geology, Antiquities, and Natural History. By W. Johnson. Pp. 304. (London: T. Fisher Unwin.) 5s. net.

Theorie und Praxis der Grossgasindustrie. By R. Mewes. i. Band, i. Hälfte. Pp. xx+403. (Leipzig: H. A. L. Degener; London: Williams and Norgate.) 18s. net.

The Natural History of the Bible. By the late Dr. H. B. Tristram. Tenth edition. Pp. viii+520. (London: S.P.C.K.) 5s.

Outlines of General Chemistry. By Prof. W. Ostwald. Translated, with the author's sanction, by Dr. W. W. Taylor. Third edition. Pp. vi+596. (London: Macmillan and Co., Ltd.) 17s. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—An Alleged Specific Instance of the Transmission of acquired Characters—Investigation and Criticism: Dr. T. G. Brown.—Further Experiments on the Cross-breeding of two Races of the Moth *Acidalia virguplaria*: W. B. Alexander.—On the Effects of Castration and Ovariotomy upon Sheep: F. H. A. Marshall.—The Causes and Prevention of Miners' Nystagmus: Dr. T. L. Llewellyn.—The Stomatograph: W. L. Balls.—Composition of the Blood Gases during the Respiration of Oxygen: G. A. Buckmaster and J. A. Gardner.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Desert of North Africa: Captain H. G. Lyons, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.—On the Theory of Blast-Roasting of Galena: C. O. Bannister.—Quick Combination Methods in Smelter Assays: A. T. French.—A Graphic Method of Illustrating the Results of Extraction Tests: H. K. Picard.

LINNEAN SOCIETY, at 8.—An Investigation of the Seedling Structure in the Leguminosæ: R. H. Compton.

FRIDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 9.—The Road: Past, Present and Future: Sir John H. A. Macdonald, K.C.B., F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Works for the Prevention of Coast-erosion: W. T. Douglass.

GEOLOGICAL SOCIETY, at 8.—Anniversary Meeting.

MONDAY, FEBRUARY 19.

ROYAL SOCIETY OF ARTS, at 8.—The Meat Industry. The Pig and its Products: Loudon M. Douglas.

VICTORIA INSTITUTE, at 4.30.—The Real Personality or Transcendental Ego: S. T. Klein.

TUESDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.—The Rate of Discount and the Price of Consols: T. T. Williams.—The Rate of Interest since 1844: R. A. Macdonald.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on Age-determination in Scales of Salmonoids, with special reference to Wye Salmon: Dr. A. T. Masterman.—Studies on Pearl Oysters. I. The Structure of the Shell and Pearls of the Ceylon Pearl Oyster (*Margaritifera vulgaris*, Schumacher), with an examination of the Cestode Theory of Pearl Production: Dr. H. Lyster Jameson.—Mimicry amongst the Blattidæ; with a Revision of the Genus *Prosoplecta*, Sauss: Robert Shelford.—Contributions to the Knowledge of the Spiders and other Arachnids of Switzerland: Rev. O. Pickard-Cambridge, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Further Cave Explorations in Gibraltar in September, 1911: Dr. W. L. H. Duckworth.—On Some Prehistoric Monuments in the Departments Gard and Bouches du Rhone: A. L. Lewis.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Features of the West African Government Railways: F. Shelford.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Discussion on Shoplighting: Papers by N. W. Prangnell and A. E. Broadberry.

WEDNESDAY, FEBRUARY 21.

ROYAL SOCIETY OF ARTS, at 8.—The British Silk Industry and its Development since 1903: F. Warner.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Fourth List of New Species of Rotifera since 1889: C. F. Rousselet.—On the Colouring of Lantern Slides, with Illustrations on the Screen: E. J. Spitta.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Thunderstorms of May 31, 1911: J. Fairgrieve.—The Thunderstorms of July 29, 1911: R. G. K. Lempfert.—The Drosometer, or Measurer of Dew: Sidney Skinner.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Variation of the Specific Heat of Water investigated by the Continuous Mixture Method: Prof. H. L. Callendar, F.R.S.—*Probable Papers*: Index to Reports of Physical Observations—Electric, Magnetic, Meteorological, Seismological—made at Kew Observatory: Dr. C. Chree, F.R.S.—On the Velocities of Ions in Dried Gases: R. T. Lattey and H. T. Tizard.—The Observation by means of a String Electrometer of Fluctuations in the Ionisation produced by γ Rays: Prof. T. H. Laby and P. W. Burbidge.—The Wave Problem of Cauchy and Poisson for Liquid of Finite Depth and for Slightly Compressible Liquid: F. B. Pidduck.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Supply and Transmission of Power in Self-contained Road Vehicles and Locomotives: J. C. Macfarlane and H. Burge.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 9.—The Gyrostatic Compass and Practical Applications of Gyrostats: George K. B. Elphinstone.

PHYSICAL SOCIETY, at 5.—A Method of Accurate Comparison of Quantities of Radium: Prof. E. Rutherford, F.R.S., and Mr. Chadwick.—The Absorption of the γ-rays by Gases: Mr. Chadwick.—On Wave-form Sifters for Alternating Currents: A. Campbell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Works for the Prevention of Coast-erosion: W. T. Douglass.

SATURDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, FEBRUARY 22, 1912.

THE STORY OF THE SOIL.

The Story of the Soil: from the Basis of Absolute Science and Real Life. By C. G. Hopkins. Pp. 350. (London: T. Werner Laurie, n.d.) Price 6*s.* net.

WHEN Dr. Cyril Hopkins sets out to write a book we know that we are in for something unconventional, but this time he has excelled himself in unconventionality, and has essayed a task that no author has attempted for the last sixty years: to tell the story of the soil in the form of a chronicle that almost amounts to a novel.

When, in 1852, Hoskyns wrote "Talpa, or the Chronicle of a Clay Farm"—to-day one of the treasures of the agricultural bibliophile—he secured the cooperation of George Cruikshank. But Dr. Hopkins does without any extraneous help, and alone and unaided boldly enters into competition, as he tells us, with popular fiction. The result is remarkable; a clear account is given of the soil in relation to the crop, and the interest of the subject is broadened by skilfully weaving in the threads of a mild novel. It will be interesting to learn whether the farmer reads this book any more readily than he does the ordinary science book that is supposed to appeal to him.

An agricultural student from Illinois, full of facts and figures, travels about the States in search of a farm. He wants to put into practice some of the ideas he has formed during his college course, and so, instead of seeking for improved land, he looks for a worked-out derelict farm. He first goes southwards and strikes a Virginian farm where the produce had fallen during one lifetime from five or six thousand bushels of wheat to five or six hundred, in a district where all the land is at least as impoverished, excepting only a few dairy farms, on which fertility was maintained at the general expense of the locality by the consumption of hay or grain bought in from neighbouring farms. And this in spite of the fact that most of the farms were managed by their old owners, a superior type of people, whose chief characteristics were "culture, refinement, and poverty."

The system of management which had brought about this deplorable state of affairs consisted in ploughing up the run-out pasture land and planting maize, wheat, or oats, followed by a mixture of clover and timothy. The latter is cut for hay for two years, then left for pasture for six or eight years, by which time weeds have crowded out the useful plants; finally a dressing of farmyard manure is applied, and the land is once more ploughed up for maize. Wheat and cattle are the principal products sold. This system, we are informed, is in regular use, and leads always to a similar deterioration. Our agricultural student decided not to settle there, but gave some advice that turned out very useful; he tested the soil with litmus paper, and found that it was acid; hydrochloric acid also showed the absence of carbonates; it was clear therefore that the soil would produce neither clover nor lucerne until lime was added, although it could still grow wheat, maize, and timothy. The question whether burnt lime or the less expensive limestone would be the better had been investigated at the Pennsylvania Experiment Station for many years in what is perhaps the most complete set of experiments in the world on this particular problem, and the result shows that finely ground limestone is superior in every way. At most railway stations in Illinois it can be obtained for 1.50 dollars a ton, this low rate being quoted because it is realised that the general prosperity of railway companies and everyone else in Illinois is bound up with the maintenance of the fertility of the soil. In Virginia, however, no such plan is in operation, so that the cost of the improvement would be considerably higher. But the addition of limestone is only the beginning; the amount of nitrogen in the soil has also to be increased, and this can only be done profitably by growing leguminous crops. Since clover only grows with difficulty, and lucerne not at all, recourse was had to inoculation, not with a bacterial culture, but with soil that had grown lucerne well. Finally, the addition of rock phosphate and an improved rotation raised the fertility of the soil considerably.

A very different problem was presented by the swamp soils of Illinois, barren in spite of their high content of humus, nitrogen, and phosphorus compounds. The Illinois Experiment Station, knowing how to set about the problem, discovered that the supply of potassium constituted the limiting factor; as soon as potassic fertilisers were added the barren soils produced great crops at the cost of about three dollars per acre. A man who had been farming some of the same soil came to see the result, and brought with him his wife and children.

"As he stood looking first on the corn on the treated and untreated land, and then at his wife and children, he broke down and cried like a child. Later he explained to the superintendent who was showing him the experiments that he had put the best of his life into that kind of land. 'The land looked rich,' he said, 'as rich as any land I ever saw. I bought it and drained it and built my house on a sandy knoll. The first crops were fairly good, and we hoped for better crops, but instead they grew worse and worse. We raised what we could on a small patch of sandy land, and kept trying to find out what we could grow on this black bogus land. Sometimes I helped the neighbours and got a little money, but my wife and I and my older children have wasted twenty years on this land. Poverty, poverty, always! How was I to know that this single substance which you call potassium was all we needed to make this land productive and valuable?'"

Thus experience by itself counts for very little; indeed, "experience is a mighty dear teacher, and if we finally learn the lesson it may be too everlasting late for us to apply it." And so, when finally our student settles down in Heart-of-Egypt, Southern Illinois, he has his soil analysed, draws up a rotation and scheme of fertilisers on the most approved principles, sets them into operation, and—very nearly fails The situation is saved by some advice given by an old farmer, who has learnt the secret of proper tillage. Moisture, in fact, had been lacking, and the fertiliser

scheme, good as it was, had no chance to show its merits until moisture-conserving tillage was adopted. Thus the young man's science and the old man's experience finally solved the problem, and that particular tract of land was conquered.

But we have only been able to give a very brief account of this delightful book. The American agricultural student and farmer are admirably drawn, and the reader also learns Dr. Hopkins's views on soil fertility, and where he differs from the Bureau of Soils. Light reading the book certainly is, as the author intended, but it has depth and permanent value.

E. J. RUSSELL.

TWO IMPORTANT WORKS ON CLIMATOLOGY.

(1) *Handbuch der Klimatologie.* By Prof. J. Hann. iii. Band. Klimatographie. 2 Teil, Klima der gemäszigten Zonen und der Polarzonen. Dritte Auflage. Pp. ix+713. (Stuttgart: J. Engelhorn's Nachf., 1911.) Price 23 marks.

(2) *Das Klima der Schweiz auf Grundlage der 37-jährigen Beobachtungsperiode* 1864–1900. Bearbeitet von Jul. Maurer, Rob. Billwiller, jr., und Clem. Hess. Preisschrift herausgegeben durch die Stiftung von Schnyder von Wartensee mit Unterstützung der schweizerischen meteorologischen Zentralanstalt. In zwei Banden. Erster Band, Text, pp. viii+302. Price 12 marks. Zweiter Band, Tabellen, pp. v+217. Price 8 marks. (Frauenfeld: Huber and Co., 1909–1910.)

WITH the third volume of his "Handbuch der Klimatologie" (1) Prof. Hann has completed the third edition of that famous work. This last volume deals with the special climatology of the temperate and polar regions. It would be difficult to find in other 700 pages of printed matter a similar collection of well-arranged facts. Not that the book is a mere collection of facts. The author has succeeded in clothing the dry bones with flesh, and the discussions of the data and the bringing of them into relation, on one hand, with the general physics of the globe, and, on the other, with the various phases of human activity, make most interesting reading. The manner in which the works of other authors are drawn on in this connection is wholly admirable.

The arrangement of the book is similar to that adopted in the second volume, which dealt with the tropics. Each section commences with a general description of the main features of the region under review. Thus when considering the Mediterranean—the world of the ancients—twenty-five pages suffice to supply a framework into which we can fit the details of the later 140 pages of special description. They bring vividly before us the essential differences between the coastal and the inland regions, the distribution of rainfall with its typical winter maximum becoming gradually modified into a summer maximum at the foot of the Alps, the peculiar temperature conditions with the remarkable warmth of the autumn months, and the principal local winds. More detailed information for each country or other division follows. This is accompanied by much tabular matter, the scope of which has been considerably extended in this edition as compared with its predecessor. Data are now given, as a rule, for all twelve months, and not merely for four characteristic months. For regions which possess no organised meteorological services the work of bringing together data from scattered sources, comparing them and calculating average values, had to be gone through. Even for regions where an organised service exists Prof. Hann has not always been satisfied with mere selection and extraction. For instance, in the tables of mean temperature he has endeavoured to correct the values so as to give the best approximation to the true daily mean wherever it was possible and necessary to do so. Great stress is laid throughout on this element, and in some cases a laborious recalculation of means has been gone through in order to realise the object.

When dealing with regions of which the majority of his readers are likely to have no personal experience, Prof. Hann has added to the discussion of the data pregnant descriptions of the effects of the climate on man, taken from the accounts of travellers or residents. These serve to bring out the salient points in a way that tables of extreme and mean values fail to do. Thus the contrast between the generally calm condition of eastern Siberia with its intense winter cold and the violent blizzards of the steppes of the western Siberian region makes little impression on our imagination until we consider the effects of these climates on man. In the east the intense cold is borne without serious discomfort, but in the steppes the wind and drifting snow render the conditions almost unbearable, though the temperature may be considerably higher. Again, the accounts of the effect on man of the snowstorms of the steppes remind us in many ways of the sandstorms of the African desert. Against both, man and beast are powerless.

Since the appearance of the second edition in 1897 our knowledge of the main features of the climate of Europe and North America has altered little. Progress has been mainly in the direction of a more thorough discussion of the data. Most of the old-established meteorological services have published summaries of the whole or of a portion of their accumulated observations. Thus for Russia we have Rykatscheff's "Climatological Atlas for the Russian Empire," for Germany Hellmann's work on the rainfall of North Germany, for France Angot's temperature tables, and for Italy Eredia's temperature and rainfall tables. For Austria the results for each province are being issued separately; those for four regions have already appeared, and have been noticed from time to time in NATURE. For the American continent we have Henry's "Climatology of the United States" and Bigelow's "Report on the Temperatures and Vapour Tensions of the United States," which have been issued by the Weather Bureau. In Australia also the establishment of a Commonwealth Weather Meteorological Bureau has already given us a new rainfall map of the continent. In other parts of the world the primary survey has been pushed forward into what were in 1897 little-known regions. Especially in South Africa has there been a great improvement consequent upon the establishment of

the Transvaal meteorological service. In no part of the world have the last few years seen a greater advance than in the Antarctic. In the second edition two pages sufficed to summarise our knowledge of its climate. In the present one twenty-two pages are assigned to it, in which we find, perhaps for the first time, a summary of all the data collected between the Ross expeditions of 1840 and Shackleton's dash for the pole.

Not the least valuable part of the book is provided by the very complete references to the sources from which information is taken or to works in which further details may be found. Many of these are to such recent publications that they can only have been added as the proof-sheets were going through the press. In such a complete work it seems almost ungrateful to ask for more, but we should have liked to see more maps included in the book. Ten diagrams seem a small allowance for 700 pages of letterpress on a subject which depends so largely on geographical distribution as climatology does. An atlas should always be at hand when the book is being consulted.

(2) It is instructive to turn from a book like the "Handbuch," which deals in the comparatively small space of 700 pages with the climate of the temperate and polar regions, to a work like that recently issued under the joint authorship of Maurer, R. Billwiller, jun., and C. Hess, on the climate of Switzerland. Two quarto volumes, together running to more than 500 pages, devoted to the climate of some 15,000 square miles of the earth's surface! We find ourselves asking what space would be required to deal equally fully with the whole area discussed by Hann. The authors have, however, had in view a totally different object. They have set themselves the task of summarising the observations which are available for their country in the year-books of the Swiss Meteorological Institute. They have followed to some extent the plan adopted in the somewhat similar publications for the provinces of Austria to which reference has been made above. Tables comprise a large part of the work. One set gives the average values for the meteorological elements usually observed at stations of the second order for ninety-five stations, based wherever possible on observations for the period 1864, the year of establishment of the Confederate meteorological service, to 1900. In the case of mean temperature normal values for the period 1864–1900 have been computed by extra-polation whenever the observations extended over a sufficiently long period to justify doing so. Another set of tables gives the monthly means for the principal elements for each year of the period for those stations which have been in operation throughout. There is thus plenty of material for the study of meteorological problems from the historical point of view. Average hourly values are also given for a few places for the most important elements. The whole forms a most valuable body of statistics.

The first volume of 300 pages is devoted to the discussion of the data. The plan adopted is a combination of that followed in France and Italy, where the distribution of one element over the whole country forms the subject of elaborate works, such as Angot's temperature tables, or Eredia's rainfall tables, and the Austrian method of considering the climate of each region as a whole. We have first a few chapters devoted to the consideration of the distribution of each element, and then a detailed discussion by regions. In the section on temperature, considerable space is devoted to the interdiurnal variability of temperature and to the frequency of changes of given magnitude. As at other places in Central Europe, the variability is smallest in September for most stations, but the mountain stations show a distinct minimum in April. The greatest variability occurs at moderate altitudes on the southern slopes of the Alps. In the section on rainfall we have a new map of the distribution of annual rainfall, based on observations at 400 stations, reduced to the forty-year period 1864–1903. The highest value is 251·4 cm. on the Säntis, at an altitude of 2500 m., the lowest 52·8 cm. at Grächen, in the Upper Rhone valley, at an altitude of 1629 m. We should have expected rather more information regarding the average depth of snow, but systematic observations thereon are of comparatively recent date. For a number of places it is possible to give the average earliest and latest dates on which snow remains lying. At stations at 1000 m. there are on the average 140 to 150 days in the year with snow lying, and during the winter months almost all days come into this category. Figures are also given for a selection of stations of the percentage of the total precipitation which falls as snow. The increase with height is approximately linear, being at the rate of 1 per cent. per 100 feet. Very interesting results are given for the records of bright sunshine on the mountain stations, for which the percentage of the possible shows a distinct maximum in winter. The Säntis records 49·3 per cent. of the possible during November, and 47·5 per cent. for December, the corresponding figure for June being 31·2 per cent. For Ben Nevis the percentages for these months are:—November, 11; December, 9; and June, 22. In an appendix Dr. Hess discusses the statistics of thunder and hailstorms, which have been collected systematically during the past twenty years.

We congratulate the authors and the Swiss Central Meteorological Institute on the completion of this most important contribution to the climatology of their country.

THE LAST VOLUME OF LORD KELVIN'S PAPERS.

Mathematical and Physical Papers. Vol vi., Voltaic Theory, Radio-activity, Electrons, Navigation and Tides, Miscellaneous. By the Right Hon. Sir William Thomson, Baron Kelvin, O.M., P.C., G.C.V.O. Arranged and revised, with brief annotations, by Sir Joseph Larmor, Sec.R.S. Pp. viii + 378. (Cambridge: University Press, 1911.) Price 10*s*.

A FEW months ago we reviewed the fourth and fifth volumes of Lord Kelvin's "Mathematical and Physical Papers," and now we have the sixth and concluding volume. Sir Joseph Larmor is to be congratulated on the conclusion of a task which,

however congenial to him, must have caused him a good deal of labour and anxiety. And the work has been done in the best possible way. The short notes appended here and there are very helpful, but the personality of the editor is never obtruded; indeed, it might sometimes, with advantage perhaps, have been more in evidence. The error, if it be one, is on the right side, and it may be that in connection with the selection of letters which we understand it is proposed to publish, we may have more of the editor's views on the various scientific questions, still unsettled, which are raised in these volumes.

The present volume contains papers on the electrification of air, on contact electricity, on radioactivity, on navigational and tidal instruments, terrestrial magnetism and the correction of the compass, and one or two of Lord Kelvin's last popular addresses. These papers are for the most part too recent for discussion here; the continued progress of research on ionisation and radio-activity is a commentary on many of them, and in any case we have no space for even a descriptive account of their content.

A word may perhaps be said on the vexed question of contact electromotive force between metals. Surely the reality of any contact difference of potentials must depend on whether or not any perceptible energy change—evolution or absorption—takes place at the surface, or rather the locality, of contact. When a part of a circuit carrying a current is moved in a magnetic field work is done upon or by that part, and energy is there absorbed or evolved, while in all parts of the circuit there is energy converted into heat with a corresponding potential gradient. And when there is change of potential from metal to liquid or from liquid to metal, or from liquid to liquid, energy changes which correspond are concerned. The process is, if anything, still more evident in thermoelectric circuits, and leads to an absolute evaluation of electromotive force. Now there must at bottom be unity of cause of electromotive force, and the existence of a finite contact electromotive force between metal and metal, which seems to have been insisted on to the last by Lord Kelvin, is, from the point of view of the energetics of the circuit, a great difficulty to some at least of those who are earnestly striving to obtain a clear and consistent view of voltaic phenomena.

The papers on radio-activity are very interesting as heroic attempts to explain on dynamical grounds, without calling into play any process of atomic disintegration, the extraordinary energy changes which radium and its products have disclosed. The comparison (p. 209) of the permanent rise of temperature of a thermometer which has radium near its bulb with the excess of temperature of a vessel containing black cloth over that of a similar vessel containing white cloth, when both vessels are immersed in baths of water exposed to the sun's rays, seems only to make the difficulty of any such explanation more evident, at least to the mind of the ordinary student. What corresponds to the sun's radiation in the radium experiment? According to this hypothesis, the radium "somehow" picks up energy of ethereal waves in a very special and effective manner. Is it not simpler and more reasonable to put down in t ordinary way the energy evolved to the chan effected in the stuff, especially as such changes a chemically manifest? It would seem so; and yet t suggestion must be received with respect and tes as far as possible, even though it appear to invo the reconsideration of many other cases of physi and chemical change.

The navigational and tidal papers are less sen tional, but are of great interest in connection w terrestrial physics. The tide-predicting machine, from the results of the analysis of tide curves, mak the past disclose the future in a very remarkab manner, and if nothing else had directly or indirect come out of the work of the British Association Com mittee on Tides, would have justified the whole e penditure on that subject. But much more has com through Lord Kelvin's and Sir George Darwin's gui ance and the work of the committee and its skill calculators the book of the tides of long period h been opened, and its secrets are being read.

As a lesson on the theory and practice of mechan ical integration the tidal analyser ought to be bett known than it is. We have not seen, except in con nection with the tidal application, any adequate popu lar account of it; and yet the machine, from the poin of view of integration-theory, and even of differenti equations, is of great interest and importance. Th machine with two complete harmonic components i periods of the ratio 1 : 2 is, or was, used for variation of atmospheric pressure; but the large machine con structed for the tidal application and described in th volume of papers before us stands inactive at Sout Kensington.

The oration on James Watt and the inaugur address delivered as chancellor of the University c Glasgow are given as interesting memorials of Lor Kelvin's lifelong association with Glasgow. The were reported in NATURE at the time, but their repro duction here gives a fitting personal note with whic to close the long and brilliant record of scientifi work which these volumes contain, a record whic is one of the most glorious scientific facts of the mos scientific age of the world's history. A. G.

SEWAGE PURIFICATION.

Modern Methods of Sewage Purification: a Guide fo the Designing and Maintenance of Sewage Purifica tion Works. By G. Bertram Kershaw. Pp. xiii+356. (London: Charles Griffin and Company, Ltd. 1911.) Price 21s. net.

IN view of the numerous text-books dealing witl the purification of sewage which have recentl appeared it would seem difficult to justify the publica tion of a further work on the subject. During th long period in which the author has been associate with the Royal Commission on Sewage Disposal h has had exceptional opportunities of personally inves tigating the various methods which have been adopte for the solution of the difficult problem of the economi disposal of sewage, and consequently he is well quali fied to undertake a treatise on the subject.

The book to a very large extent, however, owe its justification to the systematic and exhausti

manner in which the author quotes the various findings of the Commissioners, with whose work he is naturally thoroughly intimate. Considerable space is devoted in the opening chapters to a historical survey of the subject, together with a *résumé* of the various laws enacted to deal with questions of public health, river pollution, &c. Later, such questions as drainage area, water supply, sewerage system, rainfall, variation in rate of flow of sewage, &c., all of which influence in some degree the ultimate scheme of purification, are dealt with in a very complete manner.

Under the head of preliminary processes the author, of course, deals with the various methods of tank treatment. It is, however, unfortunate that in a work of this character passing reference only is made to the recent work in regard to the extension of the original idea of septic tank treatment. It would have been interesting, *e.g.* to have had the author's views on the Emscher tank of Imhoff, which at the present time is apparently creating a very favourable impression amongst Continental and American engineers.

Where difficulty is experienced in disposal of the tank sludge, it is obviously important to reduce the quantity produced to a minimum. The above tank is designed with this object, by allowing the accumulated sludge a maximum period for fermentation out of contact with the sewage passing through, and it is claimed that not only is there a considerable amount of actual destruction of the organic matter, but that the resultant sludge is of high density with consequent further diminution of volume to be dealt with. On the other hand, where the sludge can be readily disposed of without nuisance, it is very doubtful whether the increased expenditure on tank construction would be justified.

In connection with the question of tank treatment, the author's statement that nitrogen and oxygen are evolved in the septic tank requires correction. The conditions prevailing do not allow of the evolution of oxygen, and in the absence of nitrates in the sewage it is more than doubtful whether nitrogen is actually evolved. Nitrogen is usually found in septic tank gases, but in all probability it is derived from solution in the sewage and not as the result of any fermentative action. The chapter on sludge disposal is well written and comprehensive; reference, however, could with advantage have been made to the possibility of the recovery of grease from sludge, or of use in specially constructed gas producers.

The author's intimate acquaintance with the representative English sewage farms has enabled him to deal with the question of the purification of sewage on land in an excellent manner. Unfortunately the number of places where such treatment of sewage is possible in England is rapidly diminishing. When considering the question of treatment of sewage on contact beds and percolating filters, the author follows the lines laid down by the Royal Commission, and in the chapters dealing with this part of the subject elaborate quotations from the various reports of the Commission are given. It is to be observed that as regards the engineering side of the subject, the author doubtless has been to a large extent responsible for the conclusions arrived at by the Commissioners.

The importance of the remarks on p. 229, in regard to the construction of feed carriers, cannot be too strongly emphasised. The existence of channels which can only be emptied by extensive pumping operations is certainly to be avoided, on account of the trouble arising from the secondary decomposition of the sludge which periodically accumulates.

The value of the work is increased by the number of examples of works in operation, together with plans and results of treatment, although a more representative works illustrating contact-bed treatment might have been selected. The book can be recommended to sanitarians as affording a good general survey of the subject from the engineering point of view, and more particularly as being an admirable handbook to the voluminous reports of the Royal Commission on Sewage Disposal.

EDWARD ARDERN.

VERTEBRATES OF TWEED.

A Fauna of the Tweed Area. By A. H. Evans. Pp. xxviii+262. (Edinburgh: David Douglas, 1911.) Price 30*s*.

THIS is the eleventh volume of Mr. J. A. Harvie-Brown's well-known "Vertebrate Fauna of Scotland," and brings the series within sight of completion, four areas (Forth and Clyde, Solway and Dee) remaining to be dealt with. Mr. A. H. Evans is to be congratulated on the success with which he has dealt with the fascinating area of "Tweed" and sustained the high traditions of the series. In his labour of love he has been loyally helped by Mr. George Bolam, Mr. William Evans (who is treating of the Forth area), Mr. George Muirhead, Mr. Abel Chapman, and other well-known observers, not forgetting the editor himself. The beautiful illustrations which adorn the text are mostly due to photographs by Mr. William Norrie, of Fraserburgh, whose work has enhanced the value of previous volumes. They bring the habitats depicted very vividly before the eye, most of all when pleasant memories are already there.

"Tweed" is a scientifically natural area, a vast amphitheatre, facing the German Ocean, surrounded on three sides by hills of considerable height, and watered by the river Tweed and its tributaries. It includes considerable variety of habitat—the hills, the sea-cliffs, the rivers, the moors, the woods, and the fertile plains, and the fauna is correspondingly diverse. In his "Introduction" Mr. Evans directs attention to some of the features of peculiar interest. Thus it is still the haunt of some of our scarcer mammals, such as the badger and the great grey seal; and as regards birds, its peculiar interest is in connection with extension of range northward or southward. The nightingale was once identified within the limits, the nuthatch has been known to nest, the wryneck and the green woodpecker have occasionally been seen—"these birds being here approximately at the northernmost point of their range in the United Kingdom." "Of equal interest are those birds which find in the Tweed area their extreme limits to the southward, or at least have not been known to extend far beyond it in recent times." Thus a golden eagle was shot in 1877 on one of the Cheviots, where in earlier days it used to have

its eyrie; the wigeon has quite lately been proved to breed in Roxburghshire and Selkirkshire, having certainly arrived of recent years; and the eider-duck's breeding range has its southerly limit at the Farne Islands, which are included near the southern boundary of "Tweed." In short, there is a peculiar interest in the area treated of in this volume, since it occupies a distinctly intermediate faunal position between the north and the south of Great Britain.

The scope of the book needs no description. After an introduction, including a reference to previous workers, and a bibliography, the author gives a short but picturesque account of the physical features of the area, treating of the following subdivisions in order: St. Abb's Head and the Northern Hills, the Western Hills, the Southern Hills, the coast lands and islands, the Berwickshire valleys and the How of the Merse, the shires of Peebles and Selkirk, Teviotdale and Lower Tweedside, the Cheviot valleys and the English tributaries of "Tweed." Then follows the systematic part of the book—the account of the mammals and birds, reptiles, and amphibians. As the ichthyology of the district is so closely connected with that of "Forth," the fishes have been left to the volume on that area. The body of the book is rich in interesting notes, and the author has evidently spared no pains to make his faunistic records complete and accurate. This has demanded much personal verification, and a careful search among old records, many of which require that critical handling which only an experienced naturalist can give.

To give a sample of attractions which the area affords, we will quote a short paragraph in reference to north-western Northumberland:—

"In few localities in the kingdom does the naturalist find so many changing scenes within so short a distance of one another, or so easy of access. The highest hills rise to a considerable elevation, and though he can no longer visit an eagle's eyrie on Cheviot, or even hope to see the king of birds upon the summit, yet he has at least a chance of observing the peregrine falcon and the raven; the resident kites, buzzards, and hen-harriers have departed, as from most parts of England, but he may see the merlin on the moors, while sparrow-hawks, kestrels, and carrion-crows are still more common; the brown and long-eared owls are abundant, and the short-eared owl appears in the time of vole plagues; herons nest at Chillingham and other places; tufted ducks, pochards, shovellers, and teal breed within easy range; wheat-ears, ring-ousels, pied flycatchers, wood-wrens, and grasshopper-warblers occur here and there, with other of our less common passerine birds; black-headed gulls share the lakes with coots and dabchicks; and, finally, it is but a short and easy journey to the Farne Islands or the Fenham Flats."

OUR BOOK SHELF.

In and Out of Parliament: Reminiscences of a Varied Life. By the Right Hon. Robert Farquharson, P.C. Pp. xi+338. (London: Williams and Norgate, 1911.) Price 12*s*. 6*d*. net.

AFTER twenty-five years of Parliamentary life there are sure to be many interesting reminiscences in any man's experience, and when to those years are added many others spent in study and travel, the whole, summed up in easy, flowing language, forms a volume of delightful and pleasant reading. The most interesting part of the book to most people will be that devoted to "In Parliament."

Dr. Farquharson's description of his first entry into Parliament, and of the difficulties and embarrassments which surround anyone in a like position, will be recognised as very true to life by those who have gone through a like experience. Nothing probably strikes the new member, after a few first days of Parliamentary experience, as his apparent uselessness, and his utter inability to do anything "on his own." Later on perhaps things improve. The chase of that elusive object, the Speaker's eye, is interesting, if often disappointing; committee work, and the demands of his constituents, will help to occupy his time, but his first impression of Parliamentary life will not be flattering to his sense of self-importance.

To those who from time to time have raised complaints as to the ventilation of the House, Dr. Farquharson's experience as a medical man, and as a member of two committees under the chairmanship of Sir Henry Roscoe which investigated the questions of the drainage and ventilation, will be reassuring. The source from which the air is pumped and the process by which it is purified and rarefied are described, and should carry conviction to the grumblers.

Dr. Farquharson also assisted in the experiments devised by Sir Michael Foster to determine the number of micro-organisms in the air of the House during its sitting. He sat for two years on the committee which settled the constitution and building of the Science and Art Department, and supported Sir Michael Foster's opposition to the motion against vaccination. He spoke, in fact, on most questions connected with public health and the Army Medical Department.

The perusal of Dr. Farquharson's book will well repay anyone who takes an interest in the inner life of our legislators and the part which a man of science may play in the House of Commons.

Who's Who in Science (International), 1912. Edited by H. H. Stephenson. Pp. xvi+323. (London: J. A. Churchill.) Price 6*s*. net.

THE man of science will find this new publication a very useful addition to the books of reference kept on his desk. The volume begins with lists of the heads and senior professors of the world's universities, and these are followed by short biographies of the more important workers in science in all countries. A classified index brings together conveniently under their various countries the names of the men of science prominently associated with each subject. The biographies provide information as to the academic career and the important contributions to science of each person whose name is included.

Prehistoric Parables. By Wilson Bell. Illustrated by Horace Taylor. Pp. viii+63. (Halifax: Milner and Co.) Price 1*s*. net.

THE seven short stories relating to prehistoric man included in this little book are dramatic and interesting. Civilisation is only superficial in comparison with the history of man, and a scratch will often reveal the elemental human nature beneath. Mr. Bell's parables may therefore represent humanity as faithfully as any efforts to project ourselves into the mind of the past can do. He realises that to place man, as he has done, in the Carboniferous period for artistic effect has no geological sanction—and we think he has gained nothing by such a departure from fact—but overlooking this point the stories are certainly of human interest.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

FitzRoy and Darwin, 1831-36.

DARWIN'S "Naturalist's Voyage" is the principal record of a period of the greatest importance to him personally and to the world at large. There is also much interesting matter in the accounts of the voyage given in "The Life and Letters"[1] and in "More Letters." In his "Autobiography"[2] Darwin gives his impressions of FitzRoy; thus, he wrote:—

"FitzRoy's character was a singular one, with very many noble features: he was devoted to his duty, generous to a fault, bold, determined, and indomitably energetic, and an ardent friend to all under his sway." After going on to say something of FitzRoy's unfortunate temper and of one of the rare quarrels that occurred between them, he goes on:—"But after a few hours FitzRoy showed his usual magnanimity by sending an officer to me with an apology and a request that I would continue to live with him. His character was in several respects one of the most noble which I have ever known."

The interest of the following extracts is that they give the other side of the picture—that is, they supply us with FitzRoy's impressions of Darwin written in 1831–6. I am much indebted to the Hydrographer, Admiral Purey-Cust, for directing my attention to the existence of the references to my father in the correspondence of FitzRoy with the hydrographer of his day, and for allowing me to see copies of them. These the Lords of the Admiralty have been good enough to permit me to publish. In FitzRoy's "Voyages of the *Adventure* and *Beagle*," ii., p. 39, he states that he was directed to transmit reports from time to time, so that if "any disaster should happen to the *Beagle*, the fruits of the expedition should not be altogether lost." He was also directed to keep up a detailed correspondence with the hydrographer (Captain Beaufort), who, as it happens, was a personal friend.

No. 1. September 5, 1831.

"I have seen a good deal of Mr. Darwin, to-day having had nearly two hours' conversation in the morning and having since dined with him.

"I like what I see and hear of him, much, and I now request that you will apply for him to accompany me as a Naturalist. I can and will make him comfortable on board, more so perhaps than you or he would expect, and I will contrive to stow away his goods and chattels of all kinds and give him a place for a workshop.

"Upon consideration, I feel confident that he will have a much wider field for his exertions than I was inclined to anticipate on Friday last; and should we even be disappointed, by giving me the means of discharging him from the Books, he might at any time return to England or follow his own inclinations in South America or elsewhere."

On September 5, 1831, Darwin[3] had practically given up all hopes of the voyage, having seen an unfavourable letter from FitzRoy to Wood, who was a sort of intermediary between him and Darwin. It scarcely seemed worth his while to come to town, "but here I am . . . Captain FitzRoy is in town and I have seen him. It is no use attempting to praise him as much as I feel inclined to do, for you would not believe me." It appears from Darwin's letter[4] of September 9, 1831, that FitzRoy had confessed that the unfavourable letter to Wood was meant to throw cold water on Darwin's candidature; "he seems to have taken a sudden horror of the chances of having somebody he should not like on board the vessel." The more cheerful view as to a "wider field for his [C. D.'s] exertions" is presumably the official reflection of his favourable view of C. D. as a future shipmate. It is only fair to FitzRoy to remember that up to September 5 he was hampered by a friend who proposed to accompany him,[5] and that it was only on that day that FitzRoy heard that the friend could not come.

No. 2. September 12 [Monday], 1831. Spithead.

"I like what I see of Mr. Darwin very much. He will do well, I think—you are aware, I believe, that he is now with me on his way to see the *Beagle* and get an idea of the square inches he will be allowed."

In "Life and Letters," i., p. 211, Darwin says:—"I shall go on Sunday [September 11] per packet to Plymouth."

With regard to the "square inches," Darwin wrote,[6] September 19, 1831:—"My objection to the vessel is its smallness, which cramps one so for room for packing my own body and all my cases, &c., &c."

No. 3. September 15, 1831.

"He [Darwin], Captain King and I *now* think that it would be better in many respects, that he should *not* be on the *Books*, but that he should go out in a strictly *private* capacity. I am, however, *equally* ready to receive him in *either* manner, and I have recommended his asking which plan meets *your* approbation.

"P.S.—He has seen his future dwelling and is satisfied with it."

At this date Darwin certainly believed himself to be on the books, as he wrote[7] (September 9, 1831):—"Captain Beaufort says I am on the Books for victuals"; and this arrangement was adhered to.

FitzRoy[8] speaks of obtaining the services as naturalist of "Mr. Charles Darwin, a grandson of Dr. Darwin the poet, a young man of promising ability, extremely fond of geology, and indeed all branches of natural history." An order was "given by the Admiralty that he should be borne on the ship's books for provisions. The conditions asked by Mr. Darwin were that he should be at liberty to leave the *Beagle* and retire from the Expedition when he thought proper, and that he should pay a fair share of the expenses of my table."

No. 4. November 19, 1831.

"Messrs. Earle[9] and Darwin are the very men, of all others, for their employment, and I assure you that Darwin has not yet shown *one* trait which has made me feel other than glad when I reflect how much we shall be together." When this was written Darwin was expecting to sail[10] on November 30, but a series of gales prevented this, and it was not until the *Beagle* had twice been driven back to Plymouth that finally, in a dead calm, "we warped from our sheltered and picturesque retreat in Barn-pool"[11] and made a real start on December 27.

Darwin[12] had been living at Plymouth from October 24, and in a very low state of spirits, convinced that he had heart disease, but determined not to consult a doctor, lest he should be declared unfit for the voyage. It is to his credit that he was able to conceal his depressions from his leader, FitzRoy.

No. 5. March 5, 1832. Bahia.

"Darwin is a very sensible, hard-working man and a very pleasant messmate. I never saw a 'shore-going fellow' come into the ways of a ship so soon and so thoroughly as Darwin. I cannot give a stronger proof of his good sense and disposition than by saying 'Everyone respects and likes him.'" It is pleasant to find that what FitzRoy could say of Darwin after a few months' experience was substantially repeated by his other shipmates after five years' knowledge of his character. Thus, for instance, Admiral Mellersh, who was mate on board the *Beagle*, wrote:—"I think he was the only man I ever knew against whom I never heard a word said: and as people when shut up in a ship for five years are apt to get cross with each other, that is saying a good deal."[13]

[1] In these footnotes the "Naturalist's Voyage" (edit. 1860) will be referred to as N. V., "The Life and Letters" as L. and L., "More Letters" as M. L., FitzRoy's "Voyages of the *Adventure* and *Beagle*," 1839, as V. A. and B.

[2] L. and L., i., p. 60. [3] L. and L., i., p. 201. [4] L. and L., i., p. 208.

[5] L. and L., i., p. 201. [6] L. and L., i., p. 212.

[7] L. and L., i., p. 207. [8] V. A. and B., vol. ii., p. 18.

[9] Mr. Augustus Earle was an artist privately engaged by FitzRoy. He was in bad health and resigned in the summer of 1832. (V. A. and. B., ii., p. 20.)

[10] L. and L., i., p. 214. [11] V. A. and B., ii., p. 42.

[12] L. and L., i., p. 64. [13] L. and L., i., p. 222.

No. 5, continued.

FitzRoy goes on:—"He was terribly sick until we passed Teneriffe, and I sometimes doubted his fortitude holding out against such a beginning of the campaign. However, he was no sooner on his legs than anxious to set to work, and a child with a new toy could not have been more delighted than he was with St. Jago. It was odd to hear him say, after we left Porto Praya, 'Well, I am *glad* we are *quietly* at *sea* again, for I shall be able to arrange my collections and set to work more methodically.' He was sadly disappointed by not landing at Teneriffe and not seeing Madeira, but there was no alternative."

Darwin had written to his sister [14]:—"I daresay you expect I shall turn back at Madeira; if I have a morsel of stomach left I won't give up." With regard to this part of his voyage, he wrote in 1846:—"Farewell, dear FitzRoy, I often think of your many acts of kindness to me, and not seldomest on the time, no doubt quite forgotten by you, when before making Madeira, you came and arranged my hammock with your own hands, and which, as I afterwards heard, brought tears into my father's eyes." [15]

It was at St. Jago, in the Cape de Verd Islands, that his career as a discoverer in geology began. He wrote in his "Autobiography" [16]:—"That was a memorable hour to me, and how distinctly I can call to mind the low cliff of lava beneath which I rested, with the sun glaring hot, and a few strange desert plants growing near, and with living corals in the tidal pools at my feet."

No. 6. March 4, 1832. Bahia.

(Official letter to the hydrographer, extract from.)

"Mr. Darwin has found abundant occupation already, both at sea and on shore; he has obtained numbers of curious though small inhabitants of the ocean, by means of a Net made of Bunting, which might be called a floating or surface Trawl, as well as by searching the shores and the Land. In Geology he has met with far much more interesting employment in Porto Praya than he had at all anticipated. From the manner in which he pursues his occupation, his good sense, inquiring disposition, and regular habits, I am certain that you will have good reason to feel much satisfaction in the reflection that such a person is on board the *Beagle*, and the certainty that he is taking the greatest pains to make the most of time and opportunity."

The *Beagle* reached Bahia on February 29, 1832. Darwin writes [17]:—"The day has passed delightfully. Delight itself, however, is a weak term to express the feelings of a naturalist who, for the first time, has wandered by himself in a Brazilian forest." At Bahia, too, he began his speculations on the geology of South America (*loc. cit.*, p. 12).

Porto Praya is in St. Jago, already referred to in No. 5.

No. 7. April 28, 1832. Rio de Janeiro.

"Darwin is a regular Trump." On May 18, 1832, Darwin wrote [18]:—"The Captain does everything in his power to assist me, and we get on very well"; and again, "I am very good friends with all the officers."

No. 8. August 15, 1832. Monte Video.

"Mr. Darwin is a very superior young man, and the very best (as far as I can judge) that could have been selected for the task. He has a mixture of necessary qualities which makes him feel at home, and happy, and makes everyone his friend.

"By this Packet, the *Emulous*, he sends his first collection to the care of Prof. Henslow, at Cambridge, there to await his return to England. I *fancy* that, though of small things, it is numerous and valuable, and will convince the Cantabrigians that their envoy is no Idler."

The letter with which he sent the first of his collection to Henslow is published in "More Letters of Charles Darwin," i., p. 10. Apparently it was not until July, 1834, that he received Henslow's encouraging remarks about his collections.[19]

14 L. and L., i., p. 207.
15 L. and L., i., p. 332.
16 L. and L., i., p. 66.
17 N. V., p. 11.
18 L. and L., i., p. 237.
19 M. L., i., p. 14.

No. 9. August 14, 1834. Valparaiso.

"My messmate Darwin is now roaming amongst the Andes—he left me a week ago, intending to wander until the end of September."

No. 10. November 3, 1834.

"Mr. Darwin has been ill, as well as myself, though from a different cause."

Darwin [20] started on a "riding excursion" on August 14, 1834. On his way back he fell ill (September 20), and reached Valparaiso "with great difficulty" on September 27. He was kindly nursed back to health in the house of an old schoolfellow, Mr. Corfield. His father (Dr. Darwin) was apparently puzzled by Charles Darwin's description of the illness, and was unable to identify it. In later life Darwin was sometimes inclined to attribute his own breakdown in health to this South American attack. But when we remember the ill-health of his brother Erasmus there is no need to seek for any cause beyond a hereditary taint.

No. 11. January 26, 1836. Port Jackson.

"My messmate Mr. Darwin is so much the worse for a long voyage that I am most anxious to hasten as much as possible. Others are ailing and much require that rest which can only be obtained at home."

The return home was nevertheless delayed by the necessity of clearing up "some singular disagreements in the longitudes." Darwin [21] wrote:—"This zigzag manner of proceeding is very grievous; it has put the finishing touch to my feelings. I loathe, I abhor the sea and all ships which sail on it."

The most interesting point about No. 11 is Captain FitzRoy's statement about the poor state of Darwin's health. I was quite unprepared for such a statement, and it seems probable that it was the beginning of the general breakdown in health which began so soon after his return to England.

No. 12. February 3, 1836. At sea.

"My messmate Mr. Darwin is *now* pretty well; but he is a martyr to confinement and sea-sickness when under way."

No. 13. May 3, 1836. Mauritius.

"I think you will allow, at a future day, that my messmate Darwin has *well* earned his *stowage* and provisions. Though still a martyr to sea-sickness, he recovers at the sight of land, and if the weather is not very bad, does a good deal at sea, in the thinking and writing way."

FitzRoy's statement as to the amount of suffering which Darwin went through from sea-sickness quite confirms the recollections of other officers.[22] In after life he seems to me to have forgotten how much he suffered.

When he was safe home and settled in London he wrote to FitzRoy [23]:—"I think it far the *most fortunate circumstance* in my *life* that the chance afforded by your offer of taking a Naturalist fell on me." In the preface to the "Naturalist's Voyage" he wrote:—"As I feel that the opportunities which I enjoyed of studying the Natural History of the different countries we visited have been wholly due to Captain FitzRoy, I hope I may here be permitted to repeat my expression of gratitude to him, and to add that during the five years we were together I received from him the most cordial friendship and steady assistance."

The children of Charles Darwin learned from his stories a friendly feeling for those unknown companions of his travels. And I think we also learned from him to respect sailors and to agree with Fielding that "in their own element, there are no persons, near the level of their degree, who live in the constant practice of half so many good qualities."

FRANCIS DARWIN.

February 18, 1912.

Osmotic and Liquid Membranes.

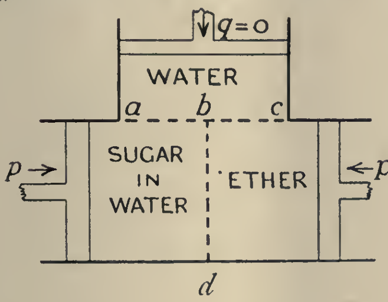
IN the Proceedings of the Royal Society (vol. lxxxvi., pp. 148–54) Prof. Trouton founds a new general method of determining osmotic pressures on experiments of the following character. He fills the closed limb of a U-tube with an aqueous solution of sugar, and places pure ether over the solution in the other limb; on applying to the

20 N. V., pp. 254, 269.
21 L. and L., i., 265.
22 L. and L., i., 224.
23 L. and L., i., 226.

contents of the tube a pressure equal to the osmotic pressure of the sugar solution, he finds that the ether takes up from the solution the same quantity of water that it would contain if it were in contact with water at atmospheric pressure.

I think it can readily be shown that these results can only be due to coincidence.

Consider the system in the figure, where *ab*, *bc*, and *bd* are membranes permeable to water only, and the left-hand compartment is filled with a solution of 600 grams of sugar to the litre—this is the solution that Prof. Trouton uses—bearing in mind that (on the assumption that the solubility of ether in the sugar solution may be neglected) the surface of separation between the sugar solution and the ether in the U-tube is a true semi-permeable membrane, then on closing *ab* and *bc*, and putting a pressure on the two pistons of $p=80$ atmos. (the osmotic pressure of the sugar solution), we have exactly Prof. Trouton's experiment.



The ether therefore takes up water from the solution until it is in osmotic equilibrium with it, but on opening the membrane *ab* the solution is in equilibrium with the water in the upper compartment, where the pressure is $q=0$; on opening the membrane *bc* the aqueous ether will also be in equilibrium with the water, for otherwise perpetual motion would ensue: in other words, p is also the osmotic pressure of the aqueous ether.

Now, if I understand Prof. Trouton's theory right, if any other solution of sugar had been placed in the sugar compartment under a pressure p', corresponding to the new concentration, the ether would have taken up the same quantity of water; therefore, by a similar process of reasoning as in the previous paragraph, the same solution of water in ether has two different osmotic pressures—which, of course, is impossible.

A general method of determining the osmotic pressures of substances not soluble in the liquid semi-permeable membrane can be deduced; it is, however, only a modification of De Vries's original isotonic method. As already pointed out, the ether takes up just such a quantity of water as to give it the same osmotic pressure as the solution; hence it is only necessary to obtain once and for all a series of determinations of the osmotic pressures of varying concentrations of water in ether (these could be derived by means of vapour-pressure measurements), and then place the sugar solution and ether in the U-tube and determine at what pressure the ether takes up enough water for it to have an osmotic pressure equal to the pressure actually upon it. It must not be forgotten that in actual work a correction will have to be applied for the varying solubility of the ether in the sugar solution. BERKELEY.

Foxcombe, February 13.

Microscope Stands.

MAY I be permitted, as having had a practical experience in both English and Continental factories in the actual manufacture and testing of microscopes, also in having made a study of microscopists' requirements in general, to pass a few comments on the subject of microscope construction lately dealt with in the letters appearing in your columns?

In respect to the question of tripod *versus* horseshoe base, certainly the tripod imparts stability to the instrument when in the horizontal position, but the same stability is also to be found in the horseshoe base as made by the more modern makers, who have extended the rear toe, or bearing point. The latest stands of a certain Continental firm greatly excel in this latter feature, which permits of inclination of the instrument to the horizontal with perfect rigidity and safety.

Moreover, the horseshoe base ensures portability to a greater extent than the tripod; and speaking from practical use, no matter which form of base is employed, in photomicrographic work clamping is absolutely necessary to ensure against vibration and the retention of perfect alignment.

The attachable mechanical stage, I have reason to know, was originally brought out in order to provide scientific workers with an accessory which could be utilised in certain branches of work only, and which it is desirable to be able to dispense with at will.

The mechanical stage built into the microscope stand is also made by Continental firms on a rotating principle, so that it can be fixed in any desired position and can be manipulated either from an angle or from the left or right side of the instrument, the cross motion moving independently from the plate on which the object-slide rests in order to avoid the fouling of the condenser, which is the trouble experienced in mechanical stages built into the stand and permitting of manipulation from one side only, as is mostly the case in English-made stands of the pattern referred to.

In the case of curtailed motions, which are adopted in order to avoid fouling, the motions become too short to be of practical use in serial work.

The use of mechanical stages is not advocated in certain branches of scientific study, and is only required at times, when the attachable form is most welcome.

The necessity of a centring device to a substage condenser in preference to the fixed form is a matter for the individual worker to determine. The question presents itself as to how many students in microscopy know how to centre a substage condenser. For all regular and ordinary classes of work, other than the highest scientific investigations, a fixed condenser is the best and an advantage, provided the objectives used are made to a strict standard throughout and are fitted to the identical instrument on which they are intended to be used.

The advanced worker who finds it necessary to employ a centring appliance would, from a practical point of view, do well to select the centring device provided for attachment to the objective and centre it to the condenser, this form being more convenient to adjust in its position at the end of the body-tube, than the centring screws fitted to the substage underneath the stage, this latter arrangement necessitating care being taken not to cut off the light received off the mirror.

If, however, the centring substage is preferred, the same is made by a Continental firm, and this also applies to the objective centring device for use on ordinary microscope stands.

Regarding the standardisation of substage fittings, it is a mechanical impossibility to make smooth sliding fittings interchangeable where tubes are employed, one of which is sprung in order to maintain a certain constant tension, unless by resorting to a pressure screw, which arrangement could, however, only be used when a centring appliance is employed. The standardisation of objectives is a totally different matter, as greater latitude is permissible in cutting the threads, the tension being obtained at the shoulder of the objective mount, *i.e.* when the objective is screwed right home.

In respect to sprung slide fittings *versus* ground-in slide bearings, it has been stated that the former are more easily adjusted by the microscopist, which dispenses with the necessity of returning the instrument to the maker as in the case of ground-in bearings; but it must be recognised that the constant adjustment necessary and ever attendant when sprung fittings are employed in vertical slides, *i.e.* coarse and fine adjustments and substage slides, immediately throws these bearings—responsible for the proper carrying of the above adjustments—and objectives and condenser, out of alignment with each other.

The adoption of slide fittings requiring to be sprung is,

from a constructional point of view, totally wrong, and this is proved by the fact that even these slides are ground to fit in the first course of manufacture, and that the springs are cut and adjustment screws provided afterwards in order to take up the looseness and shake which has already developed before the instrument has left the workshop; this will be borne out by any person with practical experience.

The perfectly constructed and accurately machined slide bearings adopted on the Continental microscopes only require slight grinding in, and consequently last for a considerably greater length of time, and if returned to the maker for readjustment, the substage, condenser, and objectives are recentred by any house which has a reputation worth maintaining.

Objectives provided with correction collars are now almost a thing of the past, as cover-glasses of a near definite thickness are no longer difficult to obtain, and what slight correction may be necessary can be effected by an easy working draw-tube of the sliding type, which can be adjusted to a nicety by adopting a twisting motion when moving the tube either up or down.

London, February 19. F. R. BRAND.

On Martian Detail.

THE present seems to me a fitting time to publish the results of nearly three years' investigation of the above subject. In the pursuit of this investigation I have visited most of the principal observatories in the world and tested their seeing conditions, and I conclude categorically that the climate at Flagstaff is immeasurably superior to that of any other observatory with which I am acquainted. At Flagstaff—by the means which experience has proved to be the best—Mars is so well seen that it is difficult to believe it the same planet, the grotesque caricatures of which are apt elsewhere to mislead the observer.

No one elsewhere seems to have realised the fundamental postulates of visual work, the first of which is that small apertures always define better than big, and that if we set a minimum of 12 to 15 in. any increase on this causes a loss of defining power.

That this is not generally known is witnessed by the scepticism of the leading optician of the firm of Alvan Clark, which, however, vanished when he performed the experiment here a few years ago. It is therefore *a priori* impossible to corroborate with vast apertures of 30 to 60 in. the results to which the smaller ones have led us.

In the face of the postulate above stated, it is impossible to believe the work of great apertures. It would be difficult to see why so much confidence has been placed in them were it not for the fact that those who uphold them have up to now never tested the truth of our postulate.

I have even met observers who averred that dark glasses were unnecessary when the planet dazzled the eye.

Those who could overlook this necessity may easily be blind to all other refinements of instrument and observer. That reduction of aperture means improvement of definition may be tested by anyone at any time with any instrument, and none but the wilfully blind can fail to be convinced.

When the above precautions are duly taken the canals are seen with a geometric reality, fineness, and clearness that is amazing. When so seen, the very strangeness of the sight at once suggests and demands the explanation that they are not natural, but artificial, features of the planet—the work of reasoning beings, whose purpose we can divine. Those who discredit the immortal discoveries of Schiaparelli and Lowell have never learned how to observe them, being wilfully or accidentally without knowledge of the proper method of seeking them.

In pursuit of this investigation I have used all apertures from 2 in. to 60 in.

No doubt remains in my mind as to the objective reality of what I have seen, and therefore with entire confidence I endorse the discoveries of Schiaparelli and the further advances made by Lowell in the same investigation. The latter has also set forth what I deem the only rational explanation conceivable to account for this most amazing concatenation of observed phenomena.

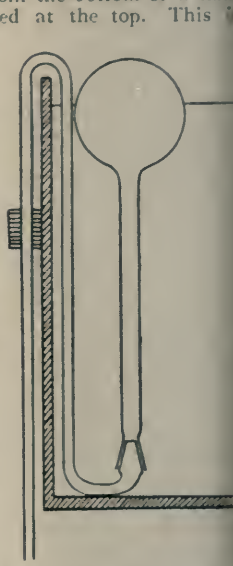
Further, I would point out to your readers that Lowell's explanation is the only complete and consistent one ever put forward, and that it can only be replaced by an equally complete one, and is not to be combated by the isolated and conflicting statements of biassed and partial judgment which up to now have been brought against it.

JAMES H. WORTHINGTON.

Lowell Observatory, Flagstaff, Arizona, January 22.

A Simple Automatic Syphon.

THE accompanying diagram illustrates a form of automatic syphon which has been found useful in cases where it is desirable to draw off water from the *bottom* of a tank at the same rate as it is supplied at the top. This is particularly important when the water has to be kept saturated with air.



The diagram represents an ordinary syphon of glass tube, the opening into the tank being ground to the form of a cone. Above this end is a float, consisting of a glass bulb and open glass stem filled with air. The lower end of the stem is ground to fit over the conical end of the syphon. Water thus escapes from the bottom of the tank through the annular space between the ground portions, and the float automatically adjusts itself so that the rate of flow of water through the syphon is exactly the same as the rate at which water enters the tank. Should the supply of water cease, the float sinks and closes the syphon.

The syphon is conveniently fixed by passing one limb through a cork cemented on to the outside of the tank. The weight of the tube maintains the float in a vertical position, while the ground end of the syphon tube keeps it stationary in the tank.

Charterhouse, Godalming. J. C. THOMSON.

Glazed Frost.

DURING the two winters that I lived in Massachusetts, glazed frosts, or "ice storms" as they were called there, were of comparatively frequent occurrence. I can recall three or four at least.

The ice storm always came after a period of very cold weather, when the temperature had been down to zero or below for some days. Suddenly the frost would break, and the thermometer rose to 32° or 33° F., the sky became overcast, and a heavy drizzle began to fall, driving before a slight wind, usually from the west. As the rain fell it froze in a clear layer upon everything exposed to its course. Trees, pavements, tram-lines, and overhead wires were covered in an hour or two to as much as 1 inch in thickness. The trams and trains had to stop running owing to the state of the rails, whilst even the thick trolley wires were unable to support the weight of the incrustation, and branches as much as 6 inches thick were broken from the trees everywhere.

The storms always came on in the morning. About noon the rain stopped, the clouds cleared away, and the sun came out. The diamond-coated branches, with showers of silvery drops falling from them, against the dark blue American sky made a scene the beauty of which can scarcely be imagined. W. ERMEN.

10 Marsden Street, Manchester, February 16.

THE INDUSTRIAL USES OF OZONE.

THE production of ozone by the discharge of a frictional electrical machine was originally noticed by Van Marum in 1785, but it was Schönbein in 1840 who first actually prepared it and gave it the name of "ozone," from the Greek ὄζων, meaning smell. He also showed that it was much more active as an oxidising agent than ordinary oxygen. As is well known, it is produced by the slow oxidation of phosphorus, and the peculiar odour of this element is really not the odour of phosphorus, but the odour of ozone, and this can be shown to be the case by adding small quantities of substances to phosphorus, which prevent its oxidation, when the odour is no longer perceptible. It also appears to be produced in small quantities by the burning of hydrocarbons. It is likewise formed in the open country, partly by evaporation, but probably most largely by the action of ultraviolet rays from the sun. This at any rate would account for its formation in the higher regions of the atmosphere. It is formed in considerable quantities when fluorine acts upon water. If a drop of water is introduced into a tube filled with fluorine, reaction immediately ensues, and the tube becomes filled with deep blue vapour. This is ozone which has a blue colour when concentrated.

Ozone is also produced at the anode when acid solutions of water are electrolysed, particularly if the electrode is a platinum tube through which cold water is passed. By this means Fischer and Massenez have obtained oxygen containing 25·27 per cent. of ozone in electrolytic oxygen by electrolysing at 0°. Such a process would not, however, be satisfactory on a large scale, owing to the cost of production. It is also produced by heating and suddenly cooling oxygen, and also by the action of the ultra-violet rays, produced by the mercury-vapour lamp. The only method employed commercially to prepare it is to subject oxygen to the action of the silent electric discharge, the oxygen thereby receiving electrical energy and becoming converted into ozone thus :—

$$3O_2 + \text{energy} = 2O_3.$$

As the formation of ozone is an endothermic reaction it follows that it is less stable than oxygen, and is in a condition in which it will readily part with the energy originally received electrically in the form of heat—*e.g.* when the pure gas explodes, or as chemical energy when it acts as an oxidising agent. The thermochemical equation accounts for its instability :—

$$O_2 + O = O_3 - 32{,}400 \text{ cal.}$$

It is only within the last decade that the employment of ozone for the purification of water has been practically worked out and actually employed commercially. Various processes have been suggested and employed for the sterilising of water, and it will perhaps be as well in the first place to refer to the different forms of construction of the apparatus. All the apparatus employed depends upon some method or other of obtaining a silent electric discharge; consequently very high electrical potential is necessary. In general the silent discharge takes place between conducting plates separated by means of a dielectric. The original ozoniser of this type was the invention of W. von Siemens, and consisted of two concentric tubes, which are coated on their outside surfaces with tinfoil, the glass of the tubes acting as the dielectric. Berthelot used glass as the dielectric and a liquid as the conducting material. Modifications of both these forms are used commercially. The "Ozonair" apparatus consists of wire gauze as the conductor, separated by mica as dielectric. The ozoniser is enclosed in an iron case when the ozone is to be produced for water sterilising or similar purposes. When it is required for the purification of the air or for ventilation it is open and the air is drawn through the apparatus and distributed by means of a fan. Fig. 1 shows a semi-enclosed type in which the grid can be entirely enclosed by completely boxing in. The electrical tension employed is about 7000 volts.

The Siemens-Halske type which is used for water sterilising is illustrated in Fig. 2. It consists of concentric pipes D and E placed one within the other; the inner one is of aluminium, and is connected with the leads carrying a high-tension current marked in the diagram as +, as this is the positive pole. The

FIG. 1.

glass cylinder E is the other pole; it is surrounded with water which can be circulated for cooling purposes, and as this is "alive" it receives its charge from it. The water which surrounds the glass cylinder receives its electricity from the iron-containing box, which is earthed, and consequently forms the negative pole. The annular space between D and E is where the silent discharge takes place. The complete apparatus consists of a cast-iron box divided into three chambers, the lower chamber for receiving and conveying the air to the ozone tubes, an hermetically sealed middle compartment into which the ozone tubes are inserted by means of a stuffing-box-gland, and an upper compartment for collecting the ozonised air. An alternating current at 8000 volts is employed.

A very high tension apparatus is the Abraham Marmier, in which a potential of 40,000 volts is employed. It is made up of a number of hollow cylindrical electrodes, which are insulated by means of glass and contained in a box. For cooling purposes water is circulated through the electrodes.

The Otto ozoniser consists of a series of transverse plates, so arranged that a dielectric plate is placed between the electrodes. The air is drawn or blown between the plates, the silent discharge passing between the spaces of the plates and thus ozonising the air. Fig. 3 shows diagrammatically the manner in which the air passes through the apparatus. An alternating current at 6500 volts is employed. In another form of the Otto ozoniser there is a metal chamber, the walls of which make one electrode. Within this chamber a number of sheet steel rings are mounted on an axle, the edges of the rings being sharpened. When in operation this bunch of rings is rotated and forms the other electrode. No dielectric is used. Air is blown through the box, the rotation of the central electrode causing thorough mixing. If an arc is struck it is immediately extinguished, as the electrode rotates because each of the rings has a groove cut in it. The tension of the current employed is about 25,000 volts.

The providing of a pure water supply to our towns, cities, and villages is of the very highest importance.

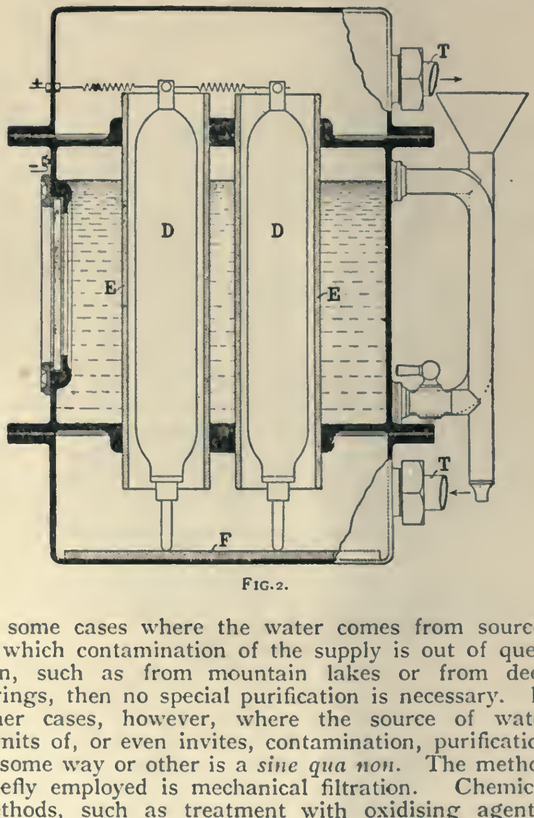


FIG. 2.

In some cases where the water comes from sources in which contamination of the supply is out of question, such as from mountain lakes or from deep springs, then no special purification is necessary. In other cases, however, where the source of water admits of, or even invites, contamination, purification in some way or other is a *sine qua non*. The method chiefly employed is mechanical filtration. Chemical methods, such as treatment with oxidising agents, can only be carried out on a small scale. The sand filtration method is partly bacterial and partly one of filtration. The surface of the sand becomes coated with a slimy deposit which is partly of bacterial formation; consequently the water first passes through the bacterial layer which exerts a beneficial effect in destroying harmful bacteria, and also makes a much finer filter than can be produced by the more or less coarse-grained sand, and then it percolates through the sand. Sometimes, however, owing to floods and special contamination, the filter-bed breaks down, and then it may be a very serious matter for the populace. Therefore where there is a possibility of water at any time being contaminated, purification by some other means is advisable.

In the Ozonair process, which is being used in this country, the ozonisation of water takes places in three stages—that is to say, the same water comes into contact with ozone three times. In the first place, the water is atomised in presence of ozonised air, and the minutely divided particles of water then fall upon the upper part of a pile of glass spheres, or other scrubbing arrangement, packed in a tower. As the water percolates down it meets an ascending stream of ozonised air. At the bottom of the tower it falls into a tank through which ozonised air is blown by means of nozzles beneath the surface of the water in the tank. The tank is in the shape of an inverted cone, and a syphon is carried to the bottom of the cone for carrying off the water. Owing to this arrangement, all the water gets equally acted upon before being carried away. The syphon discharges the water on to steps, so that it cascades down into the storage tank. As it cascades the water comes into contact with the atmosphere, and the excess of ozone is given up. Fig. 4, which is self-explanatory, shows diagrammatically the arrangement of the plant. Should the ozoniser get out of order or cease to work, the water supply is automatically cut off.

The Siemens-Halske system is largely employed on the Continent, the largest plant erected by them being at St. Petersburg. In this plant the method of sterilisation is slightly different from that previously employed. The water is conveyed into an emulsifying tower by means of special injectors, the ozonised air being used to force the water into the bottom of the tower. The water and ozone therefore enter together, and consequently very complete emulsifying takes place. The water flows over from the top of the tower, and is cascaded down to the reservoir. In this particular case the water of the Neva is the source of supply. It is very turbid, and is therefore previously treated with 30 to 40 grams of aluminium sulphate per cubic metre of water, and after settling for two hours it is filtered. The water in the first place contains a large amount of pathogenic and harmful bacteria, but after ozonising these have all disappeared. In all probability a considerable number are removed by the precipitation treatment, because when water is softened by means of lime or other precipitant it is always found to contain less bacteria than before treatment. But, of course, precipitation could not entirely be depended upon for sterilising purposes. On the other hand, ozone can be depended upon to sterilise. The St. Petersburg plant is capable of dealing with 2000 cubic metres of water per hour. There are three 150-h.p. steam engines for motive power, one, however, being always held in reserve. The whole output of the engines is not required for working the ozonisers, as the power is also used to operate the pumping and filtering plant and all the other necessary mechanical appliances. The ozonisers are worked with a three-phase alternating current at 7000 volts and 500 periods.

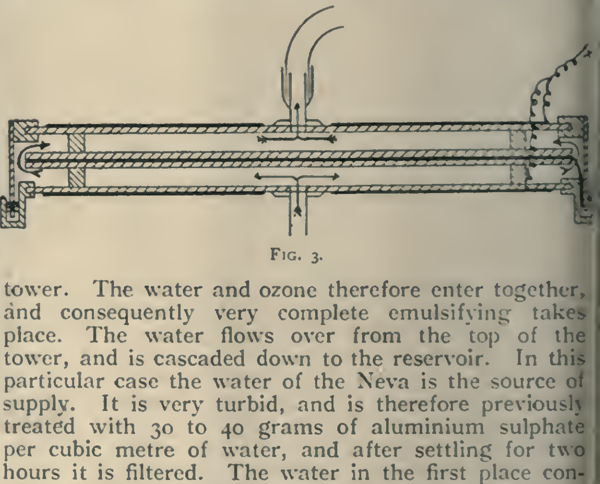


FIG. 3.

Other places on the Continent where ozone is used for sterilising the public water supply are Paderborn, Wiesbaden, Paris, Hermannstadt, Florence, Nice, Chartres, Villefranche, Rovigo, and Chemnitz. Two

new ozone plants are being installed in Paris with a daily output of 45,000 cubic meters of water.

In the United States ozone is employed at Philadelphia. The water ozonised is from the River Schuylkill in West Philadelphia. This is extremely impure, and is said to contain 2,500,000 bacteria per cubic centimetre. After treatment the number is reduced to 25 per cubic centimetre. The *Bacillus coli* which previously abounds is completely destroyed. The colour of the water is improved and its offensive odour removed.

It is obvious from the foregoing that the employment of ozone for sterilising water is now being carried out on a very considerable commercial scale, and it is found not only efficient but also very cheap. In this country to sterilise 1000 gallons of water the cost is from one halfpenny to one penny, depending upon the size of the plant and the cost of the electrical power. In connection with the sterilisation of water,

A new method for production of ozone in large quantities has just been described by E. H. Archibald and H. von Wurtenberg. Dilute sulphuric acid is electrolysed with a direct and alternating current. The alternating current acts as a depolariser, and the production of ozone is 300 times greater than with a direct current only. The maximum yield was obtained with an alternating current of 6 amperes and a continuous current of 0·25 to 1 ampere. Increase in the frequency of the alternating current increases the ozone yield.

Before leaving the question of water sterilisation another method which is now being employed should be mentioned. It has been found that the ultra-violet rays are very efficient for sterilising water. The rays are produced by a mercury-vapour arc enclosed in a

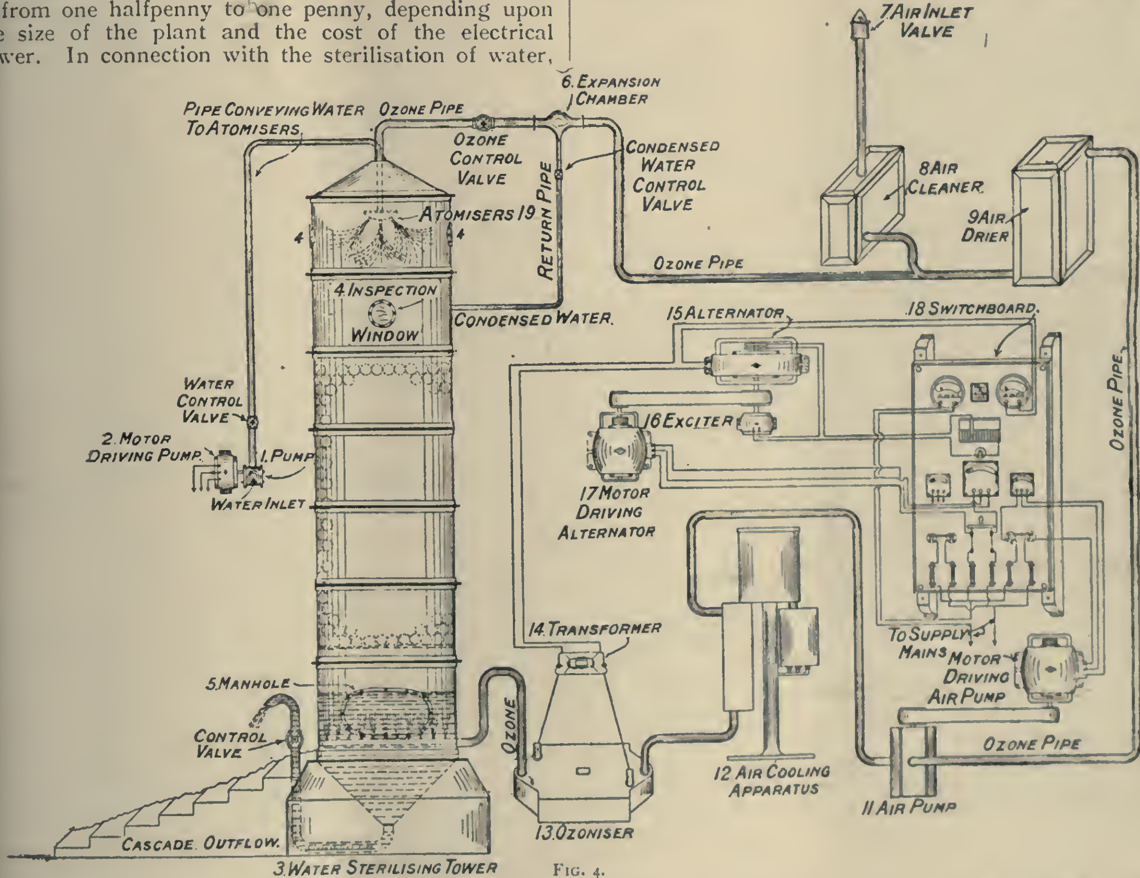


FIG. 4.

it should be mentioned that it is an easy matter by means of petrol motors to use ozone for sterilising water during campaigns. Indeed, during the Russo-Japanese war a portable plant supplied by Messrs. Siemens and Halske was employed with great success. The apparatus consists of two small wagons, each of which is hauled by one horse. The small dynamo and all the pumping appliances, &c., are worked by means of a petrol motor.

Ozone apparatus have also been devised for fitting on to the ordinary water mains, the ozoniser only functioning when the water tap is turned on. The water passes through a special form of injector which causes a thorough admixture with the ozone. At the moment the water is drawn off it smells of ozone, but within a few minutes the odour has gone off, and the water is fit for drinking purposes. This form of ozoniser is very useful in hospitals and other public institutions.

quartz tube. Under the influence of the rays from a mercury-vapour lamp of silica with a current of 3 amps. at 220 volts *B. coli* are killed in

1 second	at a distance of	10	centimetres
4 seconds	,, ,,	20	,,
15 ,,	,, ,,	40	,,
30 ,,	,, ,,	60	,,

Where water is to be sterilised it is necessary for it to be clear, because the ultra-violet rays are very rapidly absorbed. This is particularly the case if water contains colloids. The various classes of microbes are not equally sensitive; *e.g.* conditions which kill *staphylcoccus* in five seconds will kill cholera in from twenty to sixty seconds.

Lamps of glass are useless, because the glass absorbs a great portion of the rays. Fig. 5 shows the construction of the apparatus for water sterilisation brought out by the Cooper-Hewitt Westinghouse Co.

The apparatus is made to sterilise different units, the largest size being capable of dealing with 600 cubic metres in twenty-four hours. The diagram practically explains itself. L is the lamp, which is enclosed in a box with rock-crystal windows. The water to be

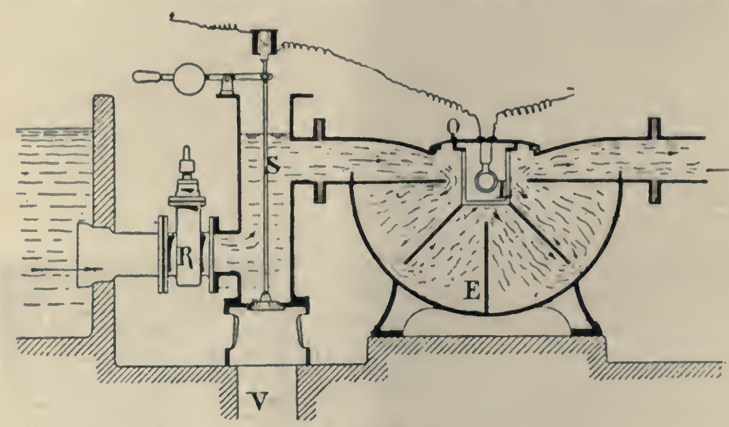


FIG. 5.

sterilised, which must, if not clear, be previously filtered, passes in at R, and by means of baffling is caused to pass three times past the rays in the steriliser E. In case of the lamp going out, there is a valve S, electromagnetically operated, which opens, and immediately prevents the water from flowing through the sterilising chamber. This apparatus is used at Rouen, where the water for the suburb Maromme-les-Rouen is sterilised by three units. Several other cities in France are also experimenting with ultra-violet sterilisation. For small scale work the ultra-violet sterilisation is very well adapted, but ozone is better for large scale operations. The great advantage of both of these processes is that nothing is added to the water. With the ultra-violet rays it is a question of killing by means of light. With ozone the sole product remaining at the end of the operation is oxygen.

Ozone, or ozonised air, is most useful for ventilating purposes. The air of crowded rooms is dangerous to health from the large percentage of noxious organic impurities, many of them bacterial, which it contains. Ordinary ventilation, while minimising these, does not entirely do away with them. If, however, the fresh air driven into the room for ventilation be previously ozonised, the organic impurities become oxidised. Ozonised air is, as a matter of fact, very largely employed in the ventilation of theatres and other large public buildings. Complaint is continually made as to the evil effect of the atmosphere of the House of Commons upon the members of Parliament, and this, in spite of strenuous efforts on the part of ventilation engineers. Probably the atmosphere would be greatly improved if the ventilating shaft which supplies fresh air to the House had an ozonising apparatus placed in it. At the Turin Exhibition the beneficial effects of ozone were forcibly brought before the notice of the writer. Ozone plant is now being employed in the ventilation of the Tube Railways with beneficial results.

Ozone is used in the manufacture of vanillin from isoeugenol. It has also been found advantageous in brewing. Weak yeast appears to be strengthened by ozone and to act more vigorously if the air of the fermenting house is kept fresh with ozonised air. Ozone is used for bleaching oils and fats, the results being very striking. It is also used for blowing oils such as linseed oil. The bleaching effect of ozone has been found useful in laundries and for bleaching delicate fabrics. Flour is bleached by means of ozone. In this case, however, as a rule the apparatus is arranged to give at the same time small quantities of oxides of nitrogen. The flour is not only bleached but also sterilised. Unbleached rye meal which contained 2400 micro-organisms per gram before treatment contained 1600 per gram after treatment. In another case, unbleached wheat flour contained 540 organisms before treatment, and 170 after treatment.

The maturing effect of ozone on wines and spirits is remarkable. Spirit which requires years for ageing is matured in a remarkably short time by emulsifying with ozone. The use of ozone in tobacco factories to aid the maturing has also been suggested.

F. MOLLWO PERKIN.

MELANESIANS.[1]

SEVERAL books, mainly by missionaries, have been written on particular islands or groups of islands in Melanesia, but with the exception of Dr. Codrington's "The Melanesians: Studies in their Anthropology and Folk-lore" (1891), there has been no general book on Melanesia, and even Dr. Codrington says very

FIG. 1.—The Rev. John Pengoni and his father. From "Islands of Enchantment."

[1] "Islands of Enchantment: Many-sided Melanesia." Seen through Many Eyes, and recorded by Florence Coombe. Pp. xxvii+382. (London: Macmillan and Co., Ltd., 1911.) 12s. net.

little about the Solomon Islands. This lack of a general survey has been supplied by Miss Florence Coombe, who has written a most admirable and interesting account of her voyaging among these fascinating islands on board the *Southern Cross*, the steam-yacht which does the business of the Melanesian Mission in great waters. And it is not as tourists and strangers that her passengers go to and fro among the groups, but rather as "friends of the family," knowing somewhat of each island's story, and having familiar acquaintances among the brown folk everywhere, so that they are received and made welcome in the homes of the people.

It is obvious that Miss Coombe could not have collected first hand all the information contained in her book; indeed, on the title-page she describes her account as "seen through many eyes, and recorded" by herself. Her indebtedness to Codrington's classical work is manifest; her acknowledgments to certain other helpers are also mentioned; but, like all travellers, she must have gained a considerable amount of casual information from missionaries. All this, combined with that gained by her own keen powers of observation, she has weaved into a bright narrative that carries the reader along without a hitch. The personal element is unobtrusive but sufficient to give continuity and unity to the narrative, and when the reader has finished the book, which he assuredly will do when he once begins it, he will find himself in possession of a general impression of Melanesia and of a large amount of detailed knowledge which cannot be gained from any single source.

Though dealing with the sphere of influence of the Melanesian Mission, the missionary element is not obtruded, and where brought in merely serves to illustrate the ameliorating influences of the "'new teaching,' or 'the way of peace,' as Christianity is called by the Melanesians." The popular treatment should give the book a large sale; on the other hand, it is a book which the ethnologist must read, as it is crowded with facts and observations, some of which are new. The very numerous and beautiful photographs, by J. W. Beattie, not only embellish the book, but afford to the student a mine of ethnographical details. Various folk-tales are interspersed throughout the book; some inevitably record the prowess of Qat, the hero of the Banks Group, one or two of which are variants of those narrated by Codrington. An interesting account is given of a visit to the little-known island of Tikopia, and the author emphasises the contrast of the natives—a Polynesian outlier in Melanesia—with those of neighbouring islands.

FIG. 2.—*Gamal* and dancing-grounds. From "Islands of Enchantment."

THE ETIOLOGY OF KALA-AZAR.

A TELEGRAM from Surgeon-General Bannerman to Sir Ronald Ross, published in *The Times* and other daily papers of February 15, announces that Captain W. S. Patton, I.M.S., "has discovered the complete development of the parasite of Kala-azar in Indian and European bed-bugs." The news, as it stands, is not quite intelligible, since Captain Patton proved in 1907 that the parasite *Leishmania donovani* went through the same development in the Indian bed-bug, *Cimex rotundatus*, that it had been discovered by Major Leonard Rogers to undergo in artificial cultures. On epidemiological grounds the

bed-bug had been indicated by Major Rogers as the probable agent in the transmission of the disease, while Major Donovan considered it more probable that another bug, *Conorhinus rubrofasciatus*, was the means of disseminating the parasite. The bare fact that the parasite developed in the bed-bug so far as its flagellated, herpetomonad stage was not in itself a decisive proof that the bed-bug was responsible for its transmission; and from the telegram received it can only be supposed that Captain Patton has completed his former investigations on the development of the parasite, and has obtained definite experimental proof of its transmission by the agency of the bed-bug.

The recent investigations of Dr. Wenyon on the allied parasite, *Leishmania tropica*, the cause of Oriental sore, make it probable that in this case the transmitting agent is a mosquito or a sand-fly (Phlebotomus sp.), sometimes also a house-fly, which may carry the infection mechanically, *i.e.* not as a true host. In North Africa and Southern Europe another species of these parasites is known, which is believed by its discoverer, Dr. Nicolle, to be primarily a parasite of dogs, and to be transmitted by some means from dogs to human beings, especially children, whence it has been given the name *L. infantum*. Dr. C. Basile in Italy has succeeded recently in transmitting this species experimentally by means of fleas. Further details of Captain Patton's investigations will be awaited with interest.

LORD LISTER, O.M., F.R.S.

BY the death of Lord Lister, the world has lost one of its greatest men, and one who, without any question, conferred more benefits on humanity than any man had ever done before. His great achievement was no doubt the revolution which he carried out in the science and practice of surgery by his investigations into the causes of septic disease, and one has only to look back at the state of surgery up to the time when he began his work to gain some idea of the enormous advance which followed.

From the earliest ages the fatal consequences of wounds, whether occurring accidentally or as a result of an operation, have occupied the minds of all those who had to do with their treatment, and all sorts of attempts have been made to obviate these evils. The practice of the ancient writers was not to keep away noxious agents which interfered with the healing of wounds, as was Lister's conception, but to *make* the wound heal, and substances were applied to *make* the flesh grow, others to *make* the growing flesh firm, and others again to *make* the wound cicatrise. Amid these attempts, the tendency of the wound itself towards healing was almost entirely lost sight of; nevertheless, there were surgeons who, from time to time, were bold enough or had insight enough to protest against these views and to point out that it is to nature itself that one must attribute the ultimate healing of the wound. However, but little attention was paid to these writers, and the practice of treating the supposed poisonous state of the surface of the wound and of inducing healing by various applications still held its own.

Paracelsus was the first who came nearest the modern ideas; he supposed that there is a juice distributed in the body which keeps the various tissues in good health and repairs them when injured, and he held that the whole aim of the surgeon ought to be to prevent alterations in this liquid, these alterations resulting mainly from contact with air. Medical applications are only of use in so far as they preserve this juice and prevent its corruption.

Similar views were held by Ambroise Paré, and it was chiefly by the writings and teachings of these two men that the position of nature as an agent in healing wounds was more fully recognised. The tendency after that time was to look on the contact of the air with the wound as the source of the main trouble, and after the chemical constitution of the air was discovered, it was the oxygen in the air which was chiefly blamed for the decomposition which took place in the wounds; indeed, this view was still held very widely when Lister began his researches on the prevention of sepsis.

The first result of these views was that enormous quantities of dressings were applied over the wounds and left unchanged for a long time, with a view of excluding the air. At the end of the eighteenth century and the beginning of the nineteenth, other methods of treatment were employed, which yielded very much better results than the older ones. One of the earliest of these methods was simple water dressing, and this was followed by irrigation, by the use of the water-bath, and in some cases by the addition of various antiseptic substances to the water so employed. Others came to the conclusion that it was best to leave the wounds open, others that healing by scabbing should be promoted, while the fear of the effect of air on wounds led to the introduction, in 1816, of subcutaneous surgery. About the middle of last century various antiseptic substances were a good deal employed, especially in France—balsams, chlorine, alcohol, chloride of zinc, iodine; and, very shortly before Lister's first publication, carbolic acid was advocated by Lemaire as an application to wounds. None of these antiseptic substances were, however, used on any definite scientific ground or with any definite method, and the result was, though a certain amount of improvement may have occurred, nothing like that which was brought about by Lister's systematic work was attained.

It is quite unnecessary to go into the details of that work; that has already been done in these columns and elsewhere. Lister was the subject of an article in the NATURE series of "Scientific Worthies" on May 7, 1896 (vol. liv., p. 1), and his collected works were reviewed in NATURE of February 17, 1910. It may be said that, from the time Lister was a student, his mind had been occupied with the terrible fatal results which so constantly followed operations, however perfectly they were conducted, and he had definitely come to the conclusion that these troubles were associated with, and indeed the result of, the putrefactive changes which occurred in the blood and serum in the wound. He felt that if only these putrefactive changes could be avoided, the dangers which resulted would, in all probability, also disappear. So long as the view was held that these changes were due to the contact of the oxygen of the air with the discharges, the matter seemed hopeless, because it seemed impossible to perform an operation under conditions which would exclude the oxygen of the air. When, however, Pasteur in his work on "Spontaneous Generation," demonstrated that the oxygen of the air was quite unable to cause fermentative changes in organic fluids, and that these changes were due to living particles which fell into these fluids from the air, these particles belonging to the class of bacteria, the outlook became much more promising, for it was quite a different matter to have to do with particles which were simply floating in the air, and were often in small numbers and even entirely absent, than with gaseous substances which could penetrate everywhere.

Two courses were open in dealing with such particles, namely, to exclude them altogether, as in the

experiments where the air was filtered through cotton-wool, or else to destroy their vitality, as in the experiments where the air which was admitted to the organic fluids was not filtered, but subjected to great heat. There is no doubt that Lister's first view was that the main organisms which produced this decomposition reached the wound from the air or from dust deposited on surrounding objects, although he very soon modified that view as a result of practical experience. Proceeding, however, on the view that the main contamination came from the air, the question which he put before himself was, what was the best way of dealing with the infective particles; should they be simply kept out by filtration of any air which came in contact with the wound, or should they be killed before they got into the wound, and if they were killed what would be the best way of doing it? To filter the air did not seem at all a practical plan, and therefore he at once took up the line of killing the organisms before they got into the wound, and the simplest way of doing so seemed to be by the use of chemical substances which had the power of destroying these minute forms of life, and were termed antiseptics. Curiously enough, the first chemical substance to which his attention was directed was carbolic acid, which still holds its place as one of the most potent and generally most applicable antiseptics.

His views and methods were constantly undergoing expansion and modification as the result of experience. Starting with the crude notion of bacteria in general, he very soon found that there must be a great variety of different species of bacteria, each having its own life-history and producing different noxious effects or none at all, and that the harm following the entrance of bacteria into wounds was, in the main, not due to those which produced the putrefactive fermentation. However much he modified his views and his methods of dealing with wounds, he held to the leading view that no bacteria should gain admission to wounds in a living state, although it was not long before he recognised that it was an ideal aim and that practically bacteria must gain entrance to wounds to a certain extent in spite of all precautions. This led him to postulate the second factor which had to do with the avoidance of sepsis, namely, the power which the tissues themselves possess in preventing the development of these micro-organisms, and that was the point on which he laid the very greatest stress, and in connection with that he struggled for years to reduce, and, if possible, avoid altogether, irritation of the tissues in the wound, while at the same time, as far as possible, preventing the entrance of bacteria. Hence he was constantly changing his dressings and his methods, much to the perplexity of those who had not grasped the scientific ideas which were at the bottom of his researches.

These changes had a twofold object: one to obtain a more perfect sterilisation of the air, and the various objects which came in contact with the wounds, and the other to avoid as far as possible the use of irritating substances, and more especially to prevent them coming in contact with the wound itself, and thus interfering with the natural action of the tissues in destroying any bacteria which might enter them in spite of the various precautions.

A study of his collected works which were published a year or two ago will show the remarkable perseverance with which he followed out these aims, and as examples of scientific writing, they are probably unsurpassed. He possessed to a high degree the quality of genius, in not overlooking what to the ordinary mind would appear minor circumstances. If an experiment did not turn out as he expected, he proceeded at once to ascertain the cause, and he did not throw it aside as simply an accident. In this way he was led to a great variety of information which the ordinary observer would have missed altogether.

But Lister as a surgeon did not direct his attentions solely to the treatment of wounds and the avoidance of septic troubles in connection with them. As soon as he found that he could reckon with reasonable certainty on the avoidance of these troubles, he proceeded to consider in what way he could improve the existing methods of treatment, and naturally the immunity from septic diseases opened up a greatly increased range of operative work. Hence very shortly after the successful application of his theories to practice, we find him suggesting operations and procedures as regards the treatment of diseases which had not previously been attempted, and were looked on by the older surgeons as almost criminal. Such operations, for example, as osteotomy for deformities, the treatment of recent fractures, such as fracture of the patella, by operation, extensive operations for the removal of cancerous glands in connection with cancer of the breast, the introduction of suprapubic colotomy, and a great many other procedures too numerous to mention.

Another point which should not be forgotten in connection with Lister is that it was his work which gave the main impulse to the development of the great science of bacteriology, a science which bids fair to occupy the most prominent place in medical work. It is true that he did not discover bacteria, nor did he take an active part in the bacteriological advances, but nevertheless he, along with Pasteur and Koch, may be looked on as a founder of the science. Until Pasteur's time the existence of bacteria and their life-history had been looked on as only an interesting but not very important study, and practically the only question asked with regard to them was whether they could arise spontaneously in organic fluids, or whether, like other living things, they must have had a progenitor. In other words, the battle raged for many years on the question of Spontaneous Generation. Pasteur was the observer who finally settled this question absolutely definitely, and showed that there was no such thing as spontaneous generation of living organisms, and that all organisms were derived from pre-existing ones, and he further showed that organisms were the causes of the ordinary fermentations, including the putrefactive fermentation.

Until, however, Lister seized on the facts demonstrated by Pasteur, and applied them to the treatment of wounds, practically no one had looked on these organisms as of any importance in disease. As soon as Lister showed that the exclusion of these organisms from wounds meant the disappearance of a variety of diseases to which man had been previously subject, the study of these organisms naturally advanced with great rapidity. Lister, for some years, did work in that direction himself, but comparatively little progress was made until it was taken up by Pasteur, who, with his wonderful insight, drew deductions from his observations of far-reaching value. But the great progress dates from the time when Koch appeared in the field, and demonstrated definitely the relation of these organisms to disease, and showed how they could be detected and how they could be stained and cultivated. Since that time the science has gone ahead at a very rapid pace; but without Pasteur, Lister, and Koch, and more especially without the practical demonstration of the great importance of these organisms by Lister, it is impossible to say whether this science would have been in existence at all at the present moment.

I need not say anything about Lord Lister as a

man. That he was conscientious to a degree, and considered any matters brought to his notice without any personal bias, is well known to all those who had dealings with him. That he never believed ill of anyone I can testify from long association with him; that those who opposed him were mistaken in their views was only a natural conclusion from the belief that he had in his own, but that any other motive influenced them in opposing him did not enter into his calculations. Above all, he was full of sympathy for suffering humanity. He spent an enormous amount of time in his hospital work, not only in making his observations and in watching the progress of the wounds under different methods of treatment, but also in relieving the suffering of the patients. He was often remonstrated with by the committees of the hospital to which he was attached for keeping patients in the hospital for a very long time, but he looked on the hospital as an institution for curing the patients, and would not let anyone leave so long as he was likely to obtain further benefit from remaining in it. When he came to London, there were several patients in his wards in Edinburgh, chiefly cases of spinal disease with abscess, who would naturally have been sent home after he left. Rather than allow them to run the risks consequent on that procedure, Lord Lister had several of them transported to London and placed in nursing homes at his own expense, and they were kept there for months, and in one case years, until the disease was cured.

W. WATSON CHEYNE.

FUNERAL SERVICE IN WESTMINSTER ABBEY.

Upon the news of Lord Lister's death, the Dean of Westminster (Bishop Ryle) at once offered the signal honour of burial in Westminster Abbey. This, however, was rendered impossible by the circumstance that it was Lord Lister's wish that he should be laid to rest at West Hampstead Cemetery, where his wife had been interred in 1893. Accordingly, the decision was taken to hold a funeral service, and to accord the full ceremonial which would have attended an actual burial within the Abbey had that been practicable.

The body was taken to the Abbey on the evening of Thursday last, in the charge of the near relatives, being received by the Dean and clergy. It was then deposited in the Chapel of St. Faith, where an offering of prayer was held.

Impressive indeed was the funeral service next day. The King was represented by Sir Frederick Treves, Queen Alexandra by Sir Francis Laking, and Princess Louise (Duchess of Argyll) by Mr. Oswald Balfour. The Prime Minister, Lord Lansdowne, the Lord Mayor of London, and the Lord Provost of Edinburgh attended. A gathering representative of the Corps Diplomatique, Government departments, British universities, scientific and medical societies, and many private individuals, all drawn by the same desire to pay a final tribute of respect, filled the Abbey in every available part.

The foreign delegates who attended were :—

M. Gabriel Lippmann, For.Mem.R.S., president, Paris Academy of Sciences, with Profs. Chaveau, For.Mem.R.S., Dastre, and Roux; Prof. Pozzi, Academy of Medicine, Paris; Prof. E. Roux, Pasteur Institute; Prof. Garré, president, German Congress of Surgeons; Prof. H. Treub, Dutch Medical Society, Amsterdam, and University of Amsterdam.

Many foreign learned societies were also represented, in addition to the foregoing, through the nomination of men of science in this country.

On the part of the Royal Society there were present :—

Sir Archibald Geikie (president, who took part as a pall bearer); Sir Alfred Kempe (treasurer); Sir Joseph Larmor and Sir John Bradford (secretaries); Sir William Crookes, O.M. (foreign secretary); Dr. Lazarus Fletcher; and Sir John Kirk.

The pall-bearers and chief mourners were as subjoined :—

Pall Bearers.

Lord Rayleigh, O.M. (past president of the Royal Society, and Order of Merit); Lord Rosebery (Chancellor of the University of London); Lord Iveagh (Lister Institute); Sir Archibald Geikie (president of the Royal Society); Principal Sir Donald MacAlister (University of Glasgow); Sir Watson Cheyne (King's College, London); Mr. R. J. Godlee (president of the Royal College of Surgeons); Prof. Francis M. Caird (University of Edinburgh).

Sir Hector Cameron (University of Glasgow), who was to have been a pall bearer, was prevented by illness from fulfilling the duty.

Chief Mourners.

Mr. J. J. Lister, F.R.S., Dr. Arthur Lister, Miss Lister, Mr. R. G. Godlee, Mr. J. Lister Godlee, Mr. Lister Harrison, Mrs. Phear, Colonel and Mrs. Montagu Broun, Mr. P. Godlee, and Miss Christina Godlee.

At the Chapter House a procession was formed, comprising the chief mourners and immediate friends, together with representatives specially designated from civic, learned, and other institutions. Preceded by the choir and officiating clergy, the coffin was borne through the Cloisters from the Chapel of St. Faith, the while the hymn "Brief life is here our portion" was sung. From the nave to the choir the opening sentences of the Burial Service were sung, in procession, to the setting by Dr. Croft. The coffin was deposited temporarily on a high catafalque at the steps of the altar. On the pall lay the insignia of the Order of Merit, Knight of the Prussian Order "pour le Mérite," and Knight Grand Cross of the Order Danebrog.

A wreath of orchids and lilies, sent by the German Emperor, and brought to the Abbey by his Excellency the German Ambassador, was carried before the bier on its way to the choir. Floral tributes came also from the Pasteur Institute, Paris, the German Society of Surgery, and Dutch Medical Society.

After the lesson, an anthem by Handel was sung. Composed for the funeral of Queen Caroline in 1737, it was chosen for the special appropriateness of the words. These are appended :—"When the ear heard him, then it blessed him: and when the eye saw him, it gave witness of him. He delivered the poor that cried: the fatherless and him that had none to help him. Kindness, meekness, and comfort were in his tongue. If there was any virtue, and if there was any praise, he thought on those things. His body is buried in peace, but his name liveth evermore." Goss's anthem, "I heard a voice," followed.

At the conclusion of the service, and whilst the coffin was being borne from the Abbey, the "Dead March" in *Saul* was played by Sir Frederick Bridge.

The following acted as stewards in the choir, transepts, and Chapter House :—

King's College Hospital: Dr. Gillett, Major Lyne, A. C. McAllister, G. Matthews, H. P. Morton, V. E. Negus, H. A. Richards.

University College Hospital: Dr. Chubb, Dr. Cowell, A. Courts, H. Waller, G. E. O. Williams.

Royal Society: T. E. James, F. A. Towle, A. H. White.

Simultaneously with the rites in the Abbey, a memorial service was held in St. Giles's Cathedral, Edin-

burgh, attended by representatives of the Corporation, the University, the Royal Colleges of Physicians and Surgeons, and the Edinburgh and Leith Medical Practitioners' Association.

MESSAGES OF SYMPATHY AND RESPECT.

Expressions of sympathy and resolutions embodying appreciation for the work accomplished by Lord Lister have been received by his family and by the Royal Society from all parts of the civilised world. Last week we referred to messages from the King, Queen Alexandra, and other members of the Royal Family, and to the telegram from the Institut Pasteur. We print below a selection, based chiefly upon reports in *The Times*, of the tributes which have been paid by foreign rulers and Governments and by learned societies everywhere, to the character and work of Lord Lister.

So large a number of messages of condolence and tributes to the memory of Lord Lister have been received by his family that some delay in sending individual replies is inevitable, and it is therefore desired to convey through the medium of the Press their grateful acknowledgment of the sympathy which has been so generally expressed.

The King's message, already referred to, stated that his Majesty shares in the feeling that the loss suffered is a universal one, for the world at large owes a debt of gratitude to Lord Lister's memory for all that he achieved to save life and to mitigate human suffering.

The following letter was received from the German Ambassador :—

By order of his Imperial Majesty the German Emperor, who knew the late Lord Lister personally, I will have the honour to lay a wreath on the resting-place of the great savant.

Will you further kindly inform the late Lord Lister's relatives that, acting under instructions from my Government, I have conveyed, through the Foreign Office, to the societies of which Lord Lister was president, the sorrow of the Imperial Chancellor and the Royal Prussian Government?

A telegram was received by Sir Archibald Geikie, K.C.B., president of the Royal Society, from the Marquis di San Giuliano, the Italian Minister for Foreign Affairs, as follows :—

I beg you to express to the Royal Society the condolences of his Majesty's Government on the death of Lord Lister, whose name will live in perpetual veneration in the grateful memory of mankind. I associate myself personally with the Royal Society's mourning, being attached to that illustrious body by many touching recollections, both of my own references to Italy at more than one of their annual reunions and of eloquent tributes paid by their most eminent speakers to the scientific glories of our country.

At the meeting of the Royal Society on Thursday last, February 15, the President (Sir Archibald Geikie) referred to the signal loss sustained by the society and by the scientific world at home and abroad by the decease of Lord Lister, in whom the society had a special interest as a past president. It was moved from the chair, and resolved by the fellows present rising in their places, that the condolence of the society be sent to the family of Lord Lister, and that the society do adjourn without transacting the business of the meeting, as a mark of respect to his memory.

The Royal Society has received the following telegrams of sympathy from foreign academies and departments of State :—

Germany.

The Prussian Department of Public Instruction mourns in sincerest sympathy with the Royal Society the grievous loss which science has experienced by the decease of their former president, the great master of surgery, Lord Lister.—VON TROTT ZU SOLZ, Prussian Minister of Instruction.

The Royal Prussian Academy of Sciences send to the Royal Society their heartfelt sympathy in the heavy loss which the society has sustained by the death of their former president. We condole sincerely with you on the decease of Lord Lister as a true benefactor of mankind, whose memory will remain in imperishable honour among all nations.—Presiding Secretary, AUWERS.

Royal Saxon Society of Sciences, Leipzig, deeply moved by Lister's death, sends warmest sympathy. (No delegates.) (Unsigned.)

Medical Society, Leipzig, sincerely laments their distinguished honorary and foreign member. Personal representation unfortunately impossible.—MARCHAND.

On the occasion of the severe loss which medical science has suffered by the decease of Lord Lister, the League of German Clinics herewith gives expression to their most sincere sympathy.—WESSEL, President, Leipzig.

The Medical Faculty of the University of Munich mourns with you at the bier of Lord Lister, one of the greatest benefactors of mankind. It will always be a glory of Great Britain that she has brought forth this son.—M. GRUBER, Dean.

The Royal Bavarian Academy of Sciences regrets that during the University term none of its members is able to take part in the obsequies of England's great son, Lord Lister, but it is at one with the whole civilised world in its grief at the demise of one of the greatest benefactors of mankind whose benevolent life-work can never be lost.—HEIFEL, President.

Russia.

Imperial Academy of Medicine, St. Petersburg, sends its sincerest condolences to the Royal Society on the death of Lord Lister, whose loss has saddened not only England, but the whole medical world.—MOISSEEFF, Secretary of the Academy.

Imperial Academy of Sciences, St. Petersburg, begs Sir Archibald Geikie as honorary member to represent the academy at the funeral of Lord Lister.—OLDENBURG, Perpetual Secretary.

Austria-Hungary.

Imperial Academy of Sciences, Vienna, profoundly deplores the death of the great surgeon and benefactor of the sick, Lord Lister, whom they were proud to count among their honorary and foreign members, and express their sincere sympathy with the Royal Society in their loss.—PRESIDENT BOEHMBAWERK, Becke.

The Hungarian Academy, Budapest.—The Hungarian Academy of Sciences sends its deepest condolence to the funeral of its great member, Lord Lister.—BERZEVIUZY, President.

Other Countries.

Academy of Sciences, Paris.—Academy will send to the obsequies of Lister, Lippmann (president), Chauveau, Dastre, Roux. At meeting of the Academy on February 12, M. Lippmann made fitting reference to Lord Lister's life and work.

(A telegram from the Pasteur Institute was published in NATURE last week.)

I join your illustrious society on behalf of the University of the Italian Scientific Institute and with my own personal condolences at the irreparable loss of Lord Lister, to whom science and humanity owes so much.—MINISTER OF PUBLIC INSTRUCTION.

Accademia dei Lincei, Rome.—The Accademia dei Lincei deplores the loss of their illustrious member, Lord Lister, and begs to be allowed to be represented at the funeral by their member, Sir Joseph Larmor.—BLASERNA, President.

Christiania University.—The Medical Faculty of Christiania University expresses sympathy to the Royal Society in the great loss sustained by the British medical profession and the whole science of medicine by the death of the father of modern surgery, Lord Lister.—DECANIS HARBITZ.

Christiania Scientific Society thanks for kind telegram regarding Lord Lister, and regrets sincerely with the Royal

Society the loss of its eminent member.—Dr. H. MOHN, President; Dr. A. JOHANNESSEN, General Secretary.

Swedish Academy of Sciences, Stockholm.—Swedish Minister, Count Wrangel, instructed to represent Swedish Academy of Sciences at Lord Lister's funeral.—DAHLGREN, President.

Prof. Treub comes to funeral ceremony Lord Lister representing the University of Amsterdam.—Rector Magnificus, Prof. WINKLER.

Dutch Medical Society, Amsterdam.—Dutch Medical Society delegates Prof. Hector Treub, of Amsterdam, to Lord Lister's funeral.—Dr. SCHREVE, Secretary.

Academy of Science, Amsterdam.—Academy Science, Amsterdam, regrets deeply cannot send delegate Lord Lister's funeral.—LORENTZ.

The Swiss Society of Natural Sciences associates with the Royal Society in its great sorrow.—SARASIN, President.

NOTES.

FOR the meeting of the British Association for the Advancement of Science, which is to be held this year at Dundee on September 4 and following days, under the presidency of Prof. E. A. Schäfer, F.R.S., the following presidents have been appointed to the various sections:—Mathematical and Physical Science, Prof. H. L. Callendar, F.R.S.; Chemistry, Prof. A. Senier; Geology, Dr. B. N. Peach, F.R.S.; Zoology, Dr. P. Chalmers Mitchell, F.R.S.; Geography, Sir Charles M. Watson, K.C.M.G., C.B., R.E.; Economic Science and Statistics, Sir Henry H. Cunynghame, K.C.B.; Engineering, Prof. A. Barr; Anthropology, Prof. G. Elliot Smith, F.R.S.; Physiology, Mr. Leonard Hill, F.R.S.; Botany, Prof. F. Keeble; Educational Science, Prof. J. Adams; Agriculture, Mr. T. H. Middleton. Agriculture will form the subject of a full section for the first time. Prof. W. H. Bragg, F.R.S., and Prof. A. Keith have been appointed to deliver the evening discourses.

THE executive committee of the British Science Guild has completed arrangements for the reading of the following papers dealing with subjects in which the Guild is taking action:—Monday, February 26, coordination of philanthropic effort, Sir Edward Brabrook, C.B.; Monday, March 11, scientific aspects of technical education, Prof. John Perry, F.R.S.; Friday, March 29, synchronisation of clocks, Major O'Meara, C.M.G. With the kind permission of the president and council of the Chemical Society, the meetings will be held in the rooms of the Chemical Society, Burlington House, Piccadilly, at 8.30 p.m.

IN reply to a question relating to agricultural research, asked in the House of Commons on Tuesday, February 20, Mr. Runciman said:—A grant of 30,000*l.* per annum will be made from the Development Fund for work at research institutes in the following subjects, viz.:—plant physiology, plant pathology (mycological side), plant breeding, fruit growing, plant nutrition, and soil problems, animal nutrition, animal breeding, animal pathology, dairy investigation, agricultural zoology, and the economics of agriculture. Negotiations are proceeding as to the places at which the work will be carried on. It is proposed to allocate an additional sum of 5000*l.* for investigations of a special character during the ensuing financial year, and I hope shortly to be in a position to announce the purposes for which this sum will be expended.

THE governing body of the Lister Institute has appointed Mr. G. Udny Yule honorary consulting statistician to the institute.

MR. CHAPMAN JONES has been elected president of the Royal Photographic Society, in succession to Lord Redesdale, and has been awarded the progress medal of the society.

ON Tuesday next, February 27, Prof. E. G. Coker will begin a course of two lectures at the Royal Institution on "Optical Determination of Stress, and some Applications to Engineering Problems."

REFERRING to the recent correspondence on glazed frost, Mr. C. Carus-Wilson directs attention to two communications by him in NATURE some years ago, viz.:—"Is Hail so Formed" (January 26, 1888) and "Super-cooled Rain Drops" (February 2, 1905).

AT Messrs. Sotheby's sale on February 19, the sum of 105*l.* was realised for the Palæolithic hornstone hammer-heads found in the bottom of an old ditch at Airdens, near Bonar Bridge, Sutherland, and described and illustrated in a paper by Dr. J. Anderson, keeper of the Scottish National Museum of Antiquities.

PROF. W. BALDWIN SPENCER, C.M.G., F.R.S., has been appointed Protector of the Aborigines in the Northern Territory of Australia. A Reuter message from Melbourne on February 15 announces that Prof. J. A. Gilruth, since 1908 professor of veterinary pathology and director of the Research Institute in Melbourne University, has been appointed Administrator of the Northern Territory by the Commonwealth Government.

THE New York correspondent of *The Times* announces that an Arctic expedition, organised by the American Museum of Natural History and the American Geographical Society, with the cooperation of Yale University and other institutions, will start in the coming summer to explore and map out the new land which Rear-Admiral Peary saw from Cape Thomas Hubbard in 1906 and named Crocker Landing. The sum of 10,000*l.* is being raised for the expedition. The expedition is to be headed by Mr. G. Borup, assistant curator of geology in the American Museum of Natural History, and Mr. D. B. MacMillan, who were both members of Admiral Peary's last Polar expedition.

A FEW months ago (September 14, 1911) we announced that an influential committee had been formed with the view of erecting a monument to Dr. J. Janssen, whose work in astrophysics is known wherever spectroscopic studies of celestial bodies are carried on. It is felt that there should be an outward and visible sign, in the form of a work of art, of the esteem in which the world of science holds Janssen's services to astronomy and civilisation. Subscriptions are solicited for this purpose, and it is hoped that the response will be both ready and generous. The officers of the organising committee are:—*President*, H. Poincaré; *vice-presidents*, B. Baillaud and G. Bigourdan; *secretary*, P. Puiseux; *treasurer*, H. Dehérain, Bibliothécaire à l'Institut, Paris, to whom contributions should be sent.

THE anniversary meeting of the Geological Society of London was held on Friday last, February 16. The officers were appointed as follows:—*President*, Dr. A. Strahan, F.R.S.; *vice-presidents*, Prof. E. J. Garwood, Dr. J. E. Marr, F.R.S., Mr. R. D. Oldham, F.R.S., and Prof. W. W. Watts, F.R.S.; *secretaries*, Dr. A. Smith Woodward, F.R.S., and Mr. H. H. Thomas; *foreign secretary*, Sir Archibald Geikie, K.C.B., President R.S.; *treasurer*, Mr. Bedford McNeill. The following awards of medals and funds were made:—Wollaston medal, Mr.

Lazarus Fletcher, F.R.S.; Murchison medal, Prof. Louis Dollo; Lyell medal, Mr. Philip Lake; Wollaston fund, Mr. C. I. Gardiner; Murchison fund, Dr. A. Morley Davies; Lyell fund, Dr. A. R. Dwerryhouse and Mr. R. H. Rastall. The president delivered his anniversary address, which dealt with the natural resources of this country in the matter of coal supply, and their probable duration.

The death is announced, at Bergen, of Dr. G. H. A. Hansen, whose name will always be associated with the discovery of the bacillus of leprosy by him in 1871. This was almost the first micro-organism associated with disease to be recognised, antedating Koch's discovery of the tubercle bacillus by ten years. Hansen regarded leprosy as a malady of an ordinary bacterial type, and he therefore hoped for the complete extinction of the disease by the segregation of the sufferers. With this end in view, he took an active part in the organisation of leper hospitals in Norway, and although his hopes have not been completely realised, these measures have considerably diminished the prevalence of leprosy in Norway. Notwithstanding the bacillus of leprosy was recognised forty years ago, it is only within the last year or two that the artificial cultivation of the organism has attained any measure of success.

It is officially announced that the Chancellor of the Exchequer is appointing a committee to report at an early date upon the considerations of general policy in respect of the problem of tuberculosis in the United Kingdom, in its preventive, curative, and other aspects, which should guide the Government and local bodies in making or aiding provision for the treatment of tuberculosis in sanatoria or other institutions or otherwise. The committee will consist of Mr. Waldorf Astor, M.P. (chairman), Dr. C. Addison, Dr. N. D. Bardswell, Mr. David Davies, M.P., Dr. A. Mearns Fraser, Dr. A. Latham, Dr. W. Leslie Mackenzie, Dr. J. C. McVail, Dr. W. J. Maguire, Sir George Newman, Dr. Arthur Newsholme, C.B., Dr. J. Niven, M.P., Mr. M. Paterson, Dr. R. W. Philip, Dr. H. Meredith Richards, Mr. T. J. Stafford, C.B., Miss Jane Walker, and Mr. J. Smith Whitaker. The secretary to the committee will be Mr. F. J. Willis, one of the assistant secretaries of the Local Government Board.

The Times of February 10 includes an article by its well-informed correspondent in Sydney upon the Australian water supply. The article mentions the great progress which has been made in the construction of storage reservoirs for the collection of winter floods down the rivers of the Murray System. It deals mainly with the supply from the wells in Queensland and the adjacent parts of eastern central Australia, and refers to the large volumes of water yielded by some of these wells at a comparatively slight cost. Many of the bore waters cannot be used for irrigation, as they are heavily charged with salts; and though it has long been known how some of the injurious alkalies could be converted into useful plant foods, these methods have not yet been applied in practice. The article recognises that the supply from the bores tends to fall off, and that some have ceased altogether. It has recently been discovered that the water of one of the bores is radio-active, which gives support to the view that some of the water is of plutonic origin. That gas pressure helps in the outflow of the well waters has been recently shown by chemical analyses. It may be hoped that the attention now being given in Australia to this great subterranean supply of water will lead to the alteration of the old policy, whereby many of the wells were allowed to run to waste.

Dr. A. P. Laurie gave his opening lecture as professor of chemistry in the Royal Academy on February 19. His subject was "Pigments Old and New, and their Value in Detecting Forgeries." He began by describing the list of pigments which were in use at the time of Pliny. He then went on to point out what pigments had been introduced in addition to these at various times in the history of art up to the present day, such as the discovery of the preparation of real ultramarine, the introduction of lakes prepared with alum, and the introduction in more recent times of such pigments as chrome yellow, cadmium yellow, artificial ultramarine, cobalt blue, and oxide of chromium green. He then proceeded to discuss the question of how far these pigments could be identified in pictures without injuring the picture, first by means of a microscopic examination of the surface with the assistance of the micro-spectroscope, and by actual but minute tests made upon the surface of the pigments, and then by the removal of very small portions by means of delicate tools at a scale much finer than that required for surgical operations on the eye, these minute portions to be mounted in paraffin and cut in sections to be microscopically examined and tested. A systematic plan for the identification of blues when mixed with white lead was shown, and many photomicrographs, on Lumière plates, of pigments magnified to 200 diameters. In conclusion, the photomicrographs of the pigments actually found on an illuminated missal letter of the fifteenth century were shown on the screen, and the means of identifying them explained. Finally, some account was given of the mediæval methods and the treatise of the monk Theophilus.

We record with regret the death of Mr. George Maw, which occurred at Kenley, Surrey, on February 7. Born in 1832, Maw was a manufacturer of artistic tiles and pottery at Broseley, Shropshire, where he formed a remarkable collection of living hardy plants. With wide scientific interests, Maw gave especial attention to botanical, geological, and antiquarian problems. His earlier studies dealt with English botany; in 1853 he discussed the plants of the Taw, Tamar, and Torridge Valleys; he discovered *Lilium pyrenaicum*, in a naturalised condition, near Molton, S. Devon. To enrich his garden he travelled widely in the mountains of Europe, Asia Minor, and North Africa; he discovered *Draba Mawii* on the Spanish Sierra Nevada, and *Saxifraga Maweana* on the mountains above Tetuan. In 1871 he accompanied Sir J. D. Hooker and Mr. J. Ball in an expedition to North Africa, and discussed the geology of the country traversed in the well-known work "Marocco and the Great Atlas," published by Messrs. Macmillan in 1878. About 1875 Maw began to concentrate his attention on the genus Crocus, as to which he became the recognised authority; in search of its species he travelled much in Greece and Asia Minor. After preliminary systematic and horticultural notices, Maw issued, in 1886, a magnificent monograph of Crocus containing quarto plates of sixty-seven species drawn and coloured by himself. Then his health gave way; in May, 1886, he left Shropshire, and had lived in retirement at Kenley ever since. Maw was a fellow of the Linnean society, which he joined in 1860, of the Geological Society, and of the Society of Antiquaries.

The trial of Galileo formed the subject of the third lecture delivered on February 14 at University College by the Quain professor of comparative law (Sir John Macdonnell), on comparative legal procedure as illustrated by historical trials. From the report in *The Times* of the following day it appears that the lecturer justly rejected the legend that Galileo was thrown into a dungeon and

tortured, while the truth is that, considering the usual mode of procedure of the Inquisition, he may almost be said to have been treated somewhat leniently. Too much stress should probably not be laid on the proceedings at Rome in 1616, as Galileo at the trial in 1633 was not mainly convicted because he had acted contrary to the engagement he had entered into seventeen years before not to teach or defend the Copernican doctrine, but because (as the sentence distinctly stated) he had made himself suspected of heresy. Galileo did not deny that he had in 1616 been officially informed that the theory of the earth's motion must not be taught as a physically true one, and he acknowledged that he had in his "Dialogue" expressed himself in such a manner that the reader might think that he believed Copernicus to be right. Sir John Macdonnell thinks that if the question had arisen a few years earlier or later, it is possible that the doctrine might not have been forbidden. But it should be remembered that the invention of the telescope in 1609 altered the state of affairs by revealing many analogies between the earth and the planets, thereby changing the question from a purely academic one into a very real one of interest to everybody. Galileo had also tried to offer a physical proof of the earth's motion by his curious theory of the tides, which certainly damaged his case still more. The trial does not present many points of special interest apart from the personality of the accused and the cause he advocated. Many Protestant theologians of that day detested the Copernican doctrine just as cordially as the Inquisition did, but they lacked the power possessed by the latter.

In *L'Anthropologie*, vol. xxii., No. 6, L'Abbé H. Breuil and M. Cabre Aguilo contribute a valuable addition to their series of studies of Palæolithic man, under the title of "Les Peintures rupestres d'Espagne," describing a number of rock-paintings at the village of Albarracin, lying in the valley of the River Guadalaviar, which enters the Mediterranean Sea near the city of Valencia. The rough sketch of a primitive horse or pony, and coloured pictures of groups of cattle with their calves, are interesting. Still more remarkable figures in these groups are those of two men, one in black, the other in white, represented in the act of discharging arrows at some animals. They closely resemble figures of the same kind found in the Cogul Cave, and remove all doubts as to the significance of the latter.

We welcome the appearance, though belated, of the first number of *The Journal of Roman Studies*, the organ of the society started last year in cooperation with the flourishing Society for the Promotion of Hellenic Studies. The most important contribution is by Mrs. S. A. Strong, a series of notes, supplementary to the official catalogue, of the remarkable exhibition, illustrative of the provinces of the Roman Empire, at the Baths of Diocletian, Rome. The exhibition has proved so successful that the authorities announce that it will remain open until the end of next April. While other countries, in particular Austria-Hungary, have contributed splendid collections of Roman provincial antiquities, it is much to be regretted that, in comparison with Germania and Gallia, that of Britannia, the rich stores of Roman antiquities in which are little known to Continental scholars, makes such a poor display. If this new Roman society had been in working order, this reproach might have been avoided; but the official attitude to Roman antiquities is obvious from the consignment, some fourteen years ago, of the Romano-British collection in the British Museum to dark corridors and dirty, inaccessible basements in favour of the Rothschild collection. It is quite time that the authorities became convinced of the need of providing adequate accommodation for valuable objects of great interest to many British antiquaries.

In the Journal of the College of Agriculture, University of Tokyo, vol. i., No. 3, Takahashi and Satō discuss the maturing of the Japanese drink "saké," and find that this is brought about by one or more varieties of the yeast *S. anomalus* (now termed *Willia anomala*). Kurono has isolated an enzyme from both saké and beer yeasts which liberates ammonia from asparagin, and Yukawa describes two new Aspergillus fungi isolated from dried tunny fish.

In *The Quarterly Journal of Experimental Physiology* for December, 1911 (vol. iv., No. 4), Dr. K. Mackenzie details the results of an experimental investigation of the mechanism of milk secretion, with special reference to the action of animal extracts. He finds that the mammary gland is, as regards its secretory activity, not under the direct influence of the nervous system, and that many organs, *e.g.* the pituitary body, corpus luteum, pineal body, involuting uterus, and the lactating mammary gland itself possess hormones which are capable of stimulating the mammary gland to activity.

"Medicines: Ancient and Modern," is the subject of an interesting article by Dr. Oliver Davis in this month's *Knowledge*. Modern remedies are largely synthetical—built up on preconceived lines by the chemist in the laboratory. The stereo-configuration of an organic compound, *i.e.* the spatial arrangement of the component atoms and groups in the compound, profoundly modify the chemical and physiological properties of a compound. This is illustrated by reference to anilin. This is a benzene nucleus into which an amino group, NH_2, has been introduced. It is far too toxic to be of much value as a medicine, but by replacing one of the hydrogen atoms of the amino group by the acetyl radicle, $COCH_3$, we obtain acetanilide or antifebrin, a well-known useful and fairly safe remedy.

It seems to be established that Rocky Mountain spotted fever, a typhus-like disease occurring in limited districts in the United States, is conveyed by a tick (*Dermacentor venustus*). Bulletin No. 105 of the Bureau of Entymology, United States Department of Agriculture, is devoted to the bionomics of this tick, with special reference to its destruction. It is considered that systematic "dipping" of the domestic animals in the localities in which the tick is found would soon result in a very large reduction in its numbers. It is estimated that an expenditure of 23,692 dollars, spread over three years, would effect this, after which a very small annual expenditure, say 600 dollars, would suffice to prevent reinfestation.

No. 1879 of the Proceedings of the U.S. National Museum is devoted to an account, by Mr. L. J. Boettcher, of experiments which have been undertaken recently for the purpose of ascertaining the best means of preserving tusks, bones, and horns from decay and damage. Owing to desiccation, tusks of animals are exceedingly liable to crack and split after death, especially in hot and dry climates. This may be prevented by saturating them with paraffin, which may either be poured into the open end of the tusk or be imbibed by immersing the whole tusk for a certain period in a bath of melted paraffin.

Under the title of "The Public Utility of Museums," Lord Sudeley has issued in pamphlet form (Kingston-on-Thames: T. J. S. Guilford and Co., Ltd.) his letters to *The Times*, together with leading articles from that journal and other papers, on the subject of "personally

conducted tours through our chief museums," a subject to which allusion has been previously made in our columns. Some of the difficulties experienced by the conductor of these peripatetic lectures at the British Museum are recorded at the end of the pamphlet, with suggested remedies. The idea of enlisting the services of amateurs to conduct these lectures would, we venture to think, prove unworkable.

In the February number of *The Museums Journal* it is stated that "the Duchess of Aosta, who is a proficient big-game shot, has sent to the Natural History Museum three fine skins of the East African giraffe, secured during her recent hunting expedition. The species was not previously represented in the collection, and it is intended to have one of the specimens mounted for exhibition." As a matter of fact, these skins, which are by no means fine, were not sent by the Duchess of Aosta, although the animals from which they were taken were shot by her Royal Highness; the species (*Giraffa reticulata*) has for several years been represented by a mounted head and neck in the east corridor of the museum, and there is no intention of mounting one of the specimens.

We have received a copy of a very interesting Guide to the Marine Aquarium at Madras, which was opened in October, 1909, and is now in full working order. The object of the aquarium is to provide an interesting display of the fishes and other marine vertebrates of Madras, and, at the same time, to furnish opportunities for their scientific study. The main entrance leads into a paved area with a central fresh-water pond, on either side of which are arranged five large tanks with glass fronts. The seaward side of the central area is occupied by a large open tank stocked with turtles, while smaller tanks are placed here and there for novelties and specimens of particular interest. The fish are captured by netting, but only a small proportion reach the aquarium, whence, once established there, they generally thrive. In one tank are exhibited both sea-snakes and fishes, and it is a remarkable fact that while none of the former have sought to attack the latter, several sea-snakes have been killed and eaten by fishes.

The first number of *The Kew Bulletin* for 1912 is largely devoted to an account of Sir Joseph Hooker. The veteran botanist's intimate association with Kew gives special colour to the sketch of his life, and another valuable feature of the present notice is the complete list of his works which is appended. The latter, which is arranged in chronological order, dates from 1837 to 1911.

Owing to the decision to give up the botanical section of *The Annals of Scottish Natural History*, a new journal entirely devoted to botany has made its appearance. The magazine, which is to include the Transactions of the Botanical Society of Edinburgh, is entitled *The Scottish Botanical Review*. It is edited by Mr. M'Taggart Cowan, jun., with the assistance of an editorial committee, and is to be issued quarterly (price 7*s*. 6*d*. per annum). The January number covers a wide field. The geological relations of staple and migratory plant-formations are dealt with by Mr. C. B. Crampton, and critical notes on British aquatics are contributed by Mr. Arthur Bennett. Notes on alien plants, new records, and ecological nomenclature as applied to marine algæ also find a place, whilst eight pages are given to reviews and book notices. The number further contains Dr. A. W. Borthwick's presidential address to the Botanical Society of Edinburgh on modern aspects of applied botany.

Among the useful operations of the International Institute of Agriculture at Rome is the publication of a monthly bulletin containing summaries of agricultural investigations. These are by far the most complete hitherto issued, and they must prove of great value to agricultural investigators, whose literature is always scattered and often inaccessible. The Bulletin is published in French and English at a low price, and can cordially be recommended to the agricultural colleges in this country.

The Live Stock Journal Almanac for 1912 contains, as usual, a history of the various breeds of stock during the past year, together with average prices and highest prices realised for pedigree animals. It is interesting to note that Great Britain still maintains its lead in live-stock breeding, and a very considerable amount of the prosperity of the agricultural community is bound up with the production of pedigree animals of high value. We read, for instance, of a young bull selling for 1050 guineas, whilst a calf sold for 1000 guineas; another bull fetched 720 guineas, while various others went for prices varying from 200 to 400 guineas.

A recent eruption of gas two miles off the south coast of Trinidad is described by Mr. Robert Anderson in *Science* for December 15, 1911. About three acres of blue mud were upheaved to some 30 ft. above the sea, and the gas thus formed a "crater of elevation." The locality lies on the prolongation of a line of similar gaseous activity in the island. The remarkable point about the eruption is that the gas became ignited on at least two occasions, the flames being visible fifty miles away. Mr. Anderson states that sparks have been struck from casings and tools of oil-wells by the impact of exploded boulders. He also suggests that electric phenomena, like those of Mt. Pelée, may have accompanied the eruption, and so have caused ignition.

A new Publication (No. 145) of the Carnegie Institution of Washington is devoted to the second part of Dr. E. C. Case's description and revision of the Permian Vertebrata of North America. This part deals with the Cotylosauria, which are generally regarded as the most primitive of known reptiles, ancestral to at least some later groups. After a brief historical summary, Dr. Case reviews all the named species in systematic order, and while quoting the original descriptions of the type specimens, adds critical remarks and new information wherever possible. He also occasionally proposes a new name himself, but it is evident that nearly all the specimens from the Permian of Texas—the chief source of the Cotylosauria proper—are too imperfect for exact determination. The late Prof. Cope's hasty method of giving names to battered fragments of bones and teeth from this formation is proved to have hindered and complicated the study of the reptiles to which they belong. One specimen, indeed, which Cope described as a skull with the external nostrils situated beneath the end of the snout (*Hypopnous squaliceps*), is now shown to be a normal skull with a second small skull, upside down, firmly adherent to the lower face of the snout and displaying its orbits, which were mistaken for the nostrils of the larger skull. Dr. Case's wide experience and careful work have enabled him to make the best use of such material, and his new memoir gives a very good general account of the osteology of the typical cotylosaurians. They seem to have been "harmless, sluggish, terrestrial herbivores, possibly fossorial in habit," and protected from their enemies by a more or less extensive bony armour.

We have occasionally directed attention to the steps taken by the U.S. Weather Bureau for utilising and

popularising the data at its disposal. In looking through its useful meteorological charts for the current month, we find it stated that the Bureau has recently installed at the Custom House in New York City a large glass weather map, embracing the area included between longitude 10° E. and 130° W., and latitude 5° and 60° N. On this the telegraphic reports received each day from land stations and from vessels at sea are entered in their proper positions, and in special cases storm tracks are also shown. In obtaining this information the Bureau has the cooperation of the wireless services of the Navy Department and the Army Signal Corps. In connection with this map there are twelve large monthly charts on rollers, each showing the average values of the various elements, for a period of twenty to forty years, for each 5° of the North Atlantic and adjacent shores, together with tracks of hurricanes and other useful information. The installation will, no doubt, be much appreciated by underwriters, shipowners, and all persons interested in maritime meteorology.

THE lecture on radio-telegraphy delivered by Prof. Howe before the Royal Society of Arts on January 31 is printed in the Journal of the society for February 2. It occupies a little more than nine pages, and gives in that small space a clear account of the fundamental principles of the subject which can be read and appreciated by anyone who has even an elementary knowledge of physical science. It does not leave the reader with a bare outline of the subject, but by means of oscillograph curves shows how in the appliances at present in use a train of waves as little damped as possible is secured, how these waves are sent in special directions, and, finally, how they are detected by the modern mineral contact type of instrument. Several important facts with regard to ease or difficulty of communication and possible interference in war time were brought out in the discussion which followed the lecture.

IN the *Revue générale des Sciences* for January 30 Dr. L. Dunoyer has an article on magnetic exploration at sea and the progress of terrestrial magnetism during the first half of the nineteenth century. He shows, in the first instance, how the elementary theory that the magnetic poles of the earth were situated on the surface was disproved by the observed variation of the dip with latitude. By means of a chart of the lines of equal dip, as observed and as calculated on the assumption that terrestrial magnetism is due to a small central magnet, he next shows how nearly this supposition reproduces the actual facts. The theory of Gauss is then given and compared with the chart of lines of equal force given by Sabine, and founded mainly on the observations of Ross. Finally, he points out how, with the advance of time, the secular changes of the magnetic elements have introduced so many uncertainties that a new survey is necessary. Such a survey the Carnegie Institution is now carrying out.

IN the current number (No. 23) of *Science Progress* a number of subjects of more than usual general scientific interest are dealt with. Sir Oliver Lodge discusses "The Æther of Space and the Principle of Relativity," and Dr. W. N. Shaw the "Structure of the Atmosphere and the Texture of Air Currents in Relation to the Problems of Aviation." Opposing views are taken in the two papers on "The Interpretation of Life" and "Vitalism," by F. Carrel and L. Doncaster respectively. Some novel experiments showing the part played by earthworms in aërating the soil are described by Dr. J. Newton Friend, more particularly as regards the rate of production by the worm of carbon dioxide. "Weeds: their Peculiarities and Distribution," by Dr. Brenchley, contains a summary of much recent work, whilst in a paper on the "Corrosion of Iron and other Metals," by Prof. Armstrong, two recent communications by Prof. W. R. Dunstan and Mr. J. R. Hill on the rusting of iron are discussed. In the latter paper the contention that the rusting of iron can be brought about by pure water and oxygen in the absence of acid is considered to be untenable, and even though "passivity" be induced by alkalis or oxidising agents, there is little doubt that in the ordinary process of rusting, carbon dioxide plays the necessary part of rendering the water a conductor, and thus establishing the conditions of electrical action.

IN a recent communication Ravenna and Zamorani (NATURE, November 2, 1911, p. 19) showed that certain seeds, which during germination produce hydrocyanic acid, have this power increased by exposure of the growing plant to light, and to an atmosphere of carbon dioxide, whereas the proportion of hydrogen cyanide is diminished by etiolation or excluding carbonic acid unless a carbohydrate, such as dextrose, is artificially supplied, when a considerable increase in its amount actually occurs even under these conditions. It was suggested that the hydrogen cyanide or cyanogenetic glucoside was formed probably by the action of inorganic nitrogen, possibly in the form of ammonia, on the carbohydrate. Experiments have since been made by Ravenna and Vecchi (*Atti dei Lincei*, vol. 20., ii., 491) on the development of hydrogen cyanide during the germination of seeds of Linum and Sorghum when small proportions of ammonium salts are present. In all cases the proportion of hydrogen cyanide formed was largely increased by the addition of 1 per cent. of ammonium chloride, as compared with seeds germinating in the presence of ordinary water alone. Hydrogen cyanide is not present in the case of Sorghum at the very commencement of germination, but only appears after a certain amount of growth has taken place and coincident with the first indication of chlorophyll. The proportion of the hydrogen cyanide gradually increases as the ammonia in the plant increases (the latter being estimated by Bosshardt's method), but in the earliest stages ammonia is present without there being any indication of hydrogen cyanide.

DEALING with the salving of submarine boat A 3, *Engineering* for February 16 states that the damage caused by the collision of this boat with the gunboat *Hazard* has been proved to be very serious. One of the rudders of the *Hazard* has been found jammed into the conning tower of the submarine boat, and the injury to the propeller disclosed when the gunboat was docked gives rise to the belief that it acted as a knife to rip the upper shellplates of the submarine boat. These facts, supported by divers' observations, make it quite certain that no airhelmets or other appliances on board could have obviated the loss of life. Owing to the exposed position in which the A 3 lies, and to the heavy weather which has prevailed since the accident, lighters have been unable to carry out the salvage work. The task has now been handed over to the Anglo-Italian Salvage Company, which is adopting the procedure of supplying externally the buoyancy which the ship has lost by most, or all, of the compartments being flooded. A number of groups of air vessels of tubular type, each series consisting of nine rubber tubes secured at top and bottom to wooden frames fitted with the necessary valves, will be sunk by being filled with water. They will be secured to the ropes now lashed around the hull of the sunken boat, and then air will be forced through the top valves in order to drive the water from the tubes. It is hoped that the necessary buoyancy will be provided by this method.

OUR ASTRONOMICAL COLUMN.

THE NOVA, OR VARIABLE, 87.1911 PERSEI.—Photographs of the region surrounding the questionable object recently announced by Herr D'Esterre as a possible nova were secured by Herren Miethe and Seegert, of Charlottenburg photographic observatory, between January 12 and 16, and are discussed in No. 4555 of the *Astronomische Nachrichten*. Six photographs, showing images of fifteenth-magnitude stars, exhibit no certain trace of the object, but on two particularly good plates there appears, in the position of D'Esterre's object, the trace of a nebulous, indefinite image, which is probably connected with it. Further observations are to be made.

OBSERVATIONS OF JUPITER.—Vol. iv. of the *Recherches astronomiques de l'Observatoire d'Utrecht* is devoted to the publication and discussion of the observations and drawings of Jupiter made by Prof. Nijland during the period 1895–1906. In the first part, Prof. Nijland discusses 156 of the drawings in detail, giving a tabulated statement of the conditions under which they were severally made, and then directs attention to some of the general features remarked. Changes of colour of the several bands, spots, and streaks were noted from time to time, and although the material does not confirm the suggestion of periodicity made by Mr. Stanley Williams, it does not contradict it.

Part ii. deals with the spots, taking the observations *seriatim*, and there are some interesting notes concerning the variability of appearance—*e.g.* the white spots occasionally seen on the Red Spot area—of these peculiar features. In part iii. the Red Spot and its mutability are treated specially, and the volume concludes with fine reproductions of the 156 drawings of the planet.

PHOTOMETRIC OBSERVATIONS OF THE ASTEROIDS.—The importance of determining the light of the asteroids, which in several instances shows strange and puzzling variations, is emphasised by Prof. E. C. Pickering in Circular 169 of the Harvard College Observatory.

To clarify matters, Prof. Pickering tabulates the photometric measures made by different observers in seven series of forty-three asteroids, and then discusses the differences of the means from the calculated values given for the magnitudes at mean opposition in the *Berliner Jahrbuch*. He finds that the term $0{\cdot}2(m_0 - 9{\cdot}0)$ gives the relation between m_0 (the *Jahrbuch* magnitude) and the mean of the residuals obtained by subtracting the mean observed magnitudes from the computed magnitudes. The photometric magnitudes corresponding to the values of m_0 given in the *Jahrbuch*, 7·0, 8·0, 9·0, 10·0, 11·0, 12·0, and 13·0, are shown to be 6·6, 7·8, 9·0, 10·2, 11·4, 12·6, and 13·8, respectively.

Prof. Pickering remarks on the convenience for photometric observations of the ephemerides for the first four asteroids given in the British Nautical Almanac, and wishes that they should be extended to Eros and several other special objects, also that they should include the values of the phase angle.

OBSERVATIONS OF COMETS.—Observations of several of the comets of 1911 are reported in Nos. 4555–56 of the *Astronomische Nachrichten* from Bothkamp, Vienna, Utrecht, and Warsaw.

Dr. Schiller gives positions and describes the appearance of 1911*b*, 1911*c*, 1911*f*, and 1911*g*, and shows in a table of reduced magnitudes the probable oscillation of the intrinsic brightness of comet 1911*c* (Brooks). Prof. Holetschek gives measures of the brightness and the diameters of comets 1911*c*, 1911*f*, and 1911*g*, while Herr Tscherny gives places for, and describes the appearance of, comets 1911*c*, 1911*f*, and 1911*g*. On September 20, 1911, an eleventh-magnitude star was easily visible through the head of 1911*c*.

OCCULTATIONS OF MARS AND THE QUESTION OF THE EXISTENCE OF A LUNAR ATMOSPHERE.—During the occultation of Mars on December 4, 1911, Prof. W. Luther, observing with the refractor of the Dusseldorf Observatory, saw the half of the planet's disc which was nearest to the moon's limb become green, as though overcast by a shadow, while the outer half was as bright as usual; this was at about 17h. 7m. 22s. (Dusseldorf M.T.). Looking through his old observations, he found a note of a similar phenomenon taking place on October 16, 1902, and suggests that these observations indicate that there exists some material, extending to about 100 km. or more above the moon's surface, which is capable of modifying, or absorbing, light given out by a body passing behind it (*Astronomische Nachrichten*, No. 4556).

SOUTH AFRICAN METEORITES.—A preliminary note on the meteorites in the Bloemfontein Museum is contributed to part iii., vol. ii., of the Transactions of the Royal Society of South Africa by Mr. W. A. Douglas Rudge.

There are in the museum three specimens, two of them portions of the same fall, which occurred at Kroonstadt on November 11, 1877, and the third a single mass which fell at Winburg in 1881.

The larger of the twin fragments is very hard, yet easily friable, so that sections could not be cut; but by grinding, a surface was exposed showing masses of malleable nickel-iron set in a matrix of hard stone. The specific gravity was found to be 3·54, and that the mass was porous was shown by the fact that the weight in water increased from 989·5 to 991·4 grams after an hour's immersion. Qualitative analysis revealed the presence of iron, nickel, aluminium, calcium, silicon, sulphur, and traces of manganese, but no carbonic acid. A preliminary quantitative analysis gave:—insoluble matter 54·68, iron 30·38, and nickel 13·21 per cent.

The Winburg meteorite is very peculiar in having veins of lustrous iron-nickel alloy running through its mass of otherwise nearly pure iron. The general mass is very soft, but the crystals are harder and much brighter. The weight of the whole is about 50 kilograms, but there is evidence that it is only a portion of a larger mass. The preliminary analysis gives:—iron soluble in dilute H_2SO_4, 92·32 per cent.; iron in crystals, 2·35 per cent.; nickel in crystals, 2·00 per cent.; and carbon and earthy matter, 0·3 per cent. It would thus appear that practically all the nickel is concentrated in the bright crystalline material forming the veins.

ASTROPHYSICS IN CANADA.[1]

THE general report presented by the chief astronomer of the Dominion of Canada, Mr. W. F. King, gives detailed reports of progress made in the departments of time service, astrophysics, and geophysics.

Meridian Circle and Time Service.—The installation of this instrument has been attended with many unusual difficulties. Considerable trouble was experienced with the foundations of the meridian circle room owing to the percolation of surface water. A partial remedy was found by constructing a reservoir of 1200 gallons capacity, but as this was still insufficient during heavy rain, the pier footings becoming waterlogged, a system of drains surrounding the outside walls would seem to be necessary. Provision has been made in the collimator piers for underground lenses as permanent marks, similar to the system which has proved so satisfactory at the Cape Observatory.

The observers appear to have also had a most unusual experience with the transit circle itself. The graduated circles were not adjusted properly on their seatings; the axis pivots were found to be made of comparatively soft metal, rendering it necessary to shrink on collars of hardened steel and rework the surfaces with the lathe at the Royal Mint workshop.

Astrophysics.—The principal work in the astrophysical division has been the spectroscopic observations of radial velocities of binaries, determined from photographic spectra taken with the prism spectrograph. Five orbits have been thus investigated, η Boötis, θ Aquilæ, α Coronæ Borealis, ϵ Herculis, β Orionis. In other systems variable velocities have been discovered. Detailed records are included of measures of the spectrograms of the above stars, with the individual velocities from each plate.

A new single-prism spectrograph for radial velocity work has been designed and constructed with a strain-free mounting similar to that at the Lick Observatory. The body of the instrument is supported at two points, with a balanced action on a third, and the system is so successful that it is stated the flexure is inappreciable when the spectrograph is turned through 180°.

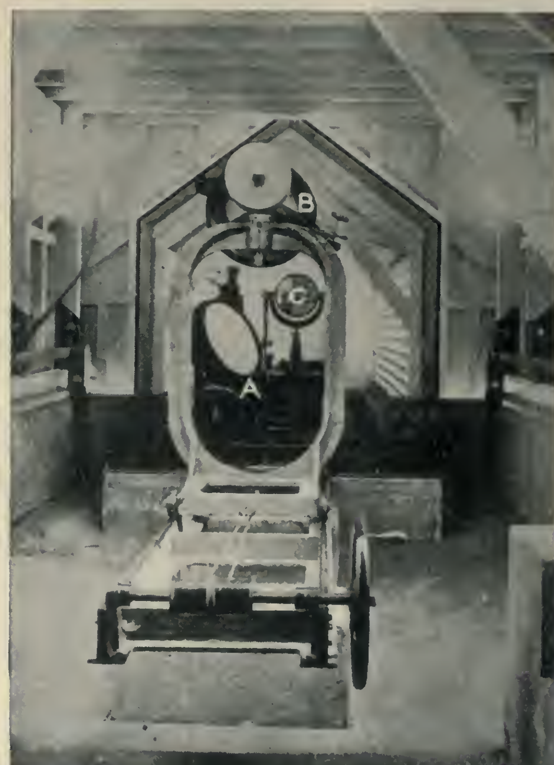
Considerable time has been spent in testing the various

1 Report of the Chief Astronomer, Ottawa, for the year ending March 31, 1909. Department of the Interior, Sessional Paper No. 25*a*. (1910.)

instruments and experimenting on the best methods of observation. A thorough test of the new Brashear doublet for stellar photography has been made by Hartmann's zonal method, and comparison photographs with different adjustments are given in illustration of the method.

Other work in this division included micrometric measurements of double stars, comet photographs, star occultations, solar photography, and adjustment of the new large grating spectrograph and cœlostat.

The cœlostat telescope is of the form installed by Hale at Mount Wilson, known as the Snow telescope, consisting of a plane mirror cœlostat with secondary mirror, concave image mirror, and Littrow spectrograph with plane diffraction grating. The main cœlostat mirror, 20 inches diameter, driven by clockwork, reflects the sunlight in a southerly direction to a secondary plane mirror, which in turn reflects the light northwards to a concave mirror, 18 inches diameter. This forms an image of the sun slightly less than 9 inches diameter on the slit plate of



View of the Ottawa cœlostat, looking north. A, main cœlostat mirror; B, secondary cœlostat mirror; C, concave image mirror.

the spectrograph, fixed in the basement of the main building of the observatory. This arrangement of mirrors is clearly shown in the accompanying illustration, taken from the report. The whole is covered by a louvred structure, part of which can be moved to allow of the sunlight reaching the cœlostat mirror at all seasons.

The large solar spectrograph is located in the basement, and consists of a 6-inch lens of 22 feet 10 inches focal length, together with a Michelson plane diffraction grating mounted in the Littrow form. The whole instrument is mounted so as to be capable of rotation about the collimation axis, this making it possible to place the slit tangential to any required point on the sun's limb.

Some interesting photographs of comet Morehouse are given showing the varying appearance presented by the tail during October and November, 1908.

Geophysics.—In the geophysical division reports are presented showing the progress of determinations of seismology, terrestrial magnetism, gravity measurements, and latitude and longitude work on numerous stations throughout the Dominion. CHARLES P. BUTLER.

THE PRECIPITIN REACTION.

THE precipitin reaction is also known as the "biological reaction" for proteins; it enables us to distinguish between proteins by using the animal body as a test-tube, and to establish differences between them which no other form of test-tube will detect. It is best known as a means for distinguishing human from other forms of blood. The procedure is briefly to inject an animal (usually a rabbit) repeatedly with a foreign protein; the serum of that animal then gives a precipitate with that protein, but with no other. So if the material injected is human blood, a precipitate is produced when the serum of the blood of the rabbit is added to human blood, or at any rate to the blood of the group of animals (the higher apes) to which man belongs, but not with any other sort of blood. The reaction is of value in forensic medicine, and it is also of value to the zoologist, as it enables him to demonstrate the blood-relationships of animals, and by the amount of precipitate to ascertain the degree of the relationship in figures.

A vast amount of research has centred around this discovery, Bordet, Uhlenhuth, Tchistowitch, and Nuttall being a few among the many who have devoted themselves to working out its details. A very clear and concise account of the principal facts has been recently published in a lecture given by Dr. W. A. Schmidt before the Cairo Scientific Society (*Cairo Scientific Journal*, November, 1911). Dr. Schmidt's name is known as one of those who have within recent years examined Egyptian mummies by chemical means, and his publications on the precipitin reaction have also been important. His lecture naturally deals with the question in a general and popular way, but includes a reference to some of his own work.

Among other interesting points, Dr. Schmidt has determined is the resistance of proteins to heat. It was formerly supposed that the "biological" property of proteins was easily destroyed by an elevated temperature, but Schmidt has shown that boiling for half an hour is necessary to abolish their power of reacting with a precipitin serum; and even although this is accomplished, the heated protein still retains the power when injected into an animal of inducing the formation of a precipitin which reacts with heated or boiled protein material. Further than this, protein may still be further "denaturalised" and retain a corresponding power; when, for instance, protein is coagulated by a high temperature, so that ordinary neutral reagents no longer dissolve it, a solution of it in dilute alkali will produce precipitin-formation in the blood of an injected animal, which will react only with the "denaturalised" protein used for the injection. This discovery extends the usefulness of the precipitin reaction, for with the precautions described by Dr. Schmidt it may be employed to detect proteins even though some of their principal chemical properties have been destroyed.

SCIENTIFIC MEMORIAL VOLUME, CELEBRATION OF THE 500TH ANNIVERSARY, UNIVERSITY OF ST. ANDREWS.

A NEATLY bound memorial volume of scientific papers was issued by the University of St. Andrews to mark, with other publications, its 500th anniversary last September, and is edited by Profs. McIntosh, Steggall, and Irvine. The first paper, on concrete representations of non-Euclidean geometry, by an able mathematician, Dr. D. M. Y. Somerville, consists of a description of the most important representations which have been devised for non-Euclidean geometry within the field of ordinary Euclidean geometry, viz.:—(1) the Cayley-Klein projective metric, or representation by straight lines referred to a conic as absolute; (2) the conform representation by circles orthogonal to a fixed circle; (3) Beltrami's geodesic representation on surfaces of constant curvature; (4) McClintock and Johnson's representation by "visual geometry"; (5) the representation by a net of conics through two fixed points; and (6) Poincaré's representation by diametral sections of a quadric surface.

The second paper is on the algebraic solution of indeterminate cubic equations, by Mr. Robert Norrie. The third, by Prof. Peddie, treats of the problem of partition

of energy, especially in radiation, with the author's usual ability, and the same may be said of the fifth paper, by the same skilful experimenter, on the deviations of the oscillations of a viscous solid from the isochronous law. Mr. J. P. Dalton gives a careful digest of the accuracy attainable with a modified form of Attwood's machine, whilst Mr. J. B. Ritchie further extends previous researches by Prof. Peddie on the dissipation of energy and other effects observed in torsional oscillation. The last of this series is an account of interesting experiments on wave impact on engineering structures, carried out by Prof. A. H. Gibson and Mr. W. N. Elgood, resulting in the conclusion that the effective internal pressure due to wave impact cannot exceed that exerted by wave impact on the face of a breakwater, and suggesting the provision of drains opening on the sheltered face.

The section devoted to chemistry contains a critical account of a new series of methylated sugars recently obtained in the Purdie Research Laboratory at St. Andrews by Prof. Irvine. The extended application of these researches is reviewed in an excellent paper by Mr. C. R. Young, whilst Mr. W. S. Denham ably treats of new methods in the preparation of anhydrides of organic acids, and Mr. R. C. Wallace deals with the relationships of indium and thallium. These researches give an indication of the importance and variety of the work recently carried out in this department. Under the section of natural history and medicine, Prof. McIntosh gives a brief history of the chair of natural history at St. Andrews, and Prof. D'Arcy Thompson reprints his presidential address to the British Association, entitled "Magnalia Naturæ: or the Greater Problems of Biology." The next paper is by Prof. E. E. Prince, dealing with the pioneer work in scientific fishery investigations at St. Andrews, and makes mention of many workers, now scattered in diverse regions, who have extended our knowledge of the department in a noteworthy manner, and by none more than the writer of the article. The last is a medical contribution on the important subject of the toxicity of local anæsthetics, by Prof. C. S. Marshall, who carried out a series of careful experiments with no fewer than eight drugs.

No zoological researches are included in the volume, since its scope was not understood until too late for the insertion of the able contributions of such well-known investigators as Dr. H. C. Williamson, Dr. H. M. Kyle, Dr. Wm. Nicoll, and many others whose names appear in the list of publications emanating from the Gatty Marine Laboratory.

THE CONTROL OF INSECT PESTS IN CANADA.

AT the meeting of the Manchester Literary and Philosophical Society on January 9, Dr. C. Gordon Hewitt, Dominion entomologist, gave an account of the ravages of insect pests in Canada, and the means taken by the Dominion Government to combat them. The annual opening up of vast tracts of country, previously wild, destroys the balance of nature, and swarms of insects, finding fresh stores available, devastate the new growths. Some of these insects are of native origin, but are more frequently introduced. Thus the Hessian fly, *Mayetiola destructor*, Say, appeared in 1816; the wheat midge, *Diplosis tritici*, Kirby, in 1828; the chinch bug, *Blissus leucopterus*, Say, in 1866; and the Colorado potato-beetle, *Leptinotarsa decemlineata*, Say, in 1870. The larch sawfly, *Lygaconematus erichsonii*, Hartig, reached Canada in 1882, and in a few years destroyed the mature larches over practically the whole of eastern Canada. The pear-leaf blister-mite, *Eriophyes pyri*, Nalepa, was first reported from Nova Scotia about 1887, and has since spread across Canada from the Atlantic to the Pacific.

Other pests referred to included the clover-root borer, *Hylesinus trifolii*, Müller; the warble-fly; the apple fruit-miner, *Argyresthia conjugella*, Z.; the apple maggot, *Rhagoletis pomonella*, Walsh; and the San José scale, *Aspidiotus perniciosus*, Comst. It was found necessary to pass the San José Scale Act, prohibiting the importation of trees and nursery stock from countries in which the scale was known to exist; in 1901 the restriction was removed, but infected plants were fumigated by prussic acid before admission. The brown-tail moth, *Euproctis chrysorrhoea*, L., has now reached Canada, and is attacking oak, elm, and maple, in addition to fruit trees. Contrary to expectations, the severe winters of Canada do not prove to be so fatal to the larvæ; experience has shown that some 30 per cent. survive after being frozen for two months in a block of ice. Attention is therefore being given to the parasites of this species; also the severely infested trees are sprayed to kill the young larvæ.

Dr. Hewitt gave an account of the precautionary measures taken and of legislation in the Dominion, and of the history of the Entomological Department there. Educational work is undertaken, and agriculturists and associations addressed on the means of prevention and control of outbreaks. At Ontario Agricultural College, and in other provinces, men are trained to act as assistants and inspectors in this branch.

"EXTERNAL" DEGREES AT THE UNIVERSITY OF LONDON.

SIR WILLIAM RAMSAY'S letter to NATURE on the value of the "external" degrees of the University of London, published on February 1 (vol. lxxxviii., p. 445), has given rise to a number of letters upon the subject. As several correspondents traverse the same ground, and limitations of space will not permit us to publish the letters in full, we subjoin a summary of the chief points raised.

Dr. A. D. Waller, F.R.S., thinks that no useful purpose would be served by any discussion of the particular case cited by Sir William Ramsay, where it is suggested an injustice has been done to a late student of University College, and proceeds to consider the principle involved. He urges that the great desideratum as regards the superior degrees of the University—"internal" as well as "external"—is not the abolition of the "external" degree, but publicity during examination of both kinds. A candidate presenting a doctoral thesis to the University is, says Dr. Waller, in the position of an investigator presenting a communication to a learned society, and ought to be called upon, or permitted, to expound and uphold his thesis by speech and by demonstration in the presence of the University. The "external" examinations ought not, he maintains, to be abolished, for they have been, and are, of far-reaching value as affording a guide to study and a standard of excellence throughout the Empire.

Prof. T. Johnson, of the Royal College of Science, Dublin, directs attention to the fact that the University of London was founded, in part, for students whom circumstances prevent from attendance at the London courses of instruction, and argues against the abolition of the "external" side in the University. He contends that the agitation for the conversion of the examining into a teaching university had its origin largely in the unpublished desire to safeguard certain vested interests. It was no uncommon thing in the old days, he says, for a professor in a London college to find his salary reduced owing to loss of fees caused by his replacement, at the end of his term of office as an examiner, by a provincial or other examiner. "This 'anomaly' or 'injustice' was removed by the creation of the University's teaching side and intern examinerships."

Mr. W. J. Oakes, of the Oakes Institute, Walton, Liverpool, emphasises the similarity in the requirements, so far as the arts courses are concerned, for "internal" and "external" degrees, and attaches great importance to the fact that "external" candidates for science degrees must provide suitably attested evidence of practical training in a laboratory. He points out the comparatively small provision in provincial centres of scholarships to enable young men and women to attend day courses at local universities. He asks, "What are the young men who come from homes where the income is less than 200*l*. a year to do?" If no other case could be made out for the "external" degree than that of the young men who cannot possibly attend the day classes of a university, this would, Mr. Oakes says, outweigh all the arguments which can be advanced against it.

SOME PHASES OF THE COAL-DUST QUESTION.[1]

UP to the year 1875 all great colliery explosions in this country were attributed to the accidental ignition of a large volume of firedamp that had either previously existed in an abandoned empty space, or goaf (like that which admittedly caused the Whitehaven explosion in May 1910), or was supposed to have burst suddenly into the workings and filled them with inflammable gas. In the absence of a goaf, and when, for some reason or other, the occurrence of an "outburst of gas" was not assumed, the cause of the explosion was described as a mystery.

In 1845 Faraday and Lyell directed attention to the presence of crusts of coked coal-dust and to the evidences of intense heat which they had observed in the workings of Haswell Colliery after an explosion, which they, no doubt correctly, assumed had been caused by the accidental ignition of a large quantity of firedamp in the goaf. Following up that assumption, they remarked that "there was every reason to believe that much coal-gas was made from this dust in the very air itself of the mine by the flame of the firedamp, which raised and swept it along."

These words indicate clearly, I think, what was in their minds, namely, that the participation of the coal-dust was an important, but by no means an essential, incident in the firedamp explosion.

During the fifteen years preceding 1875 some French engineers expressed the opinion that coal-dust must have greatly lengthened the flame of certain small explosions of firedamp and blasting shots, and aggravated the consequences to a corresponding extent; and one of them, M. Verpilleux (whom, however, none of his contemporaries seemed disposed to follow), went so far as to compare, in relative importance, the initial flame with that of the priming, and the coal-dust flame with that of the discharge, of a gun.

I had been seeking for a rational explanation of great explosions for some years before I came to South Wales as assistant inspector on mines. Before that time I had had much experience in investigating the causes of small firedamp explosions in damp and wet mines in Scotland, but of no explosions of any kind in dry and dusty mines. Accordingly, when I found that all the great explosions in this district had occurred in mines of the latter, and none of those of the former class, I began to associate them with the presence of coal-dust. Acting under this impression, I made experiments in the summer (July 3) of 1875 with a mixture of coal-dust and air, which was made to flow through the small wooden apparatus described in my first paper on coal-dust referred to hereafter. I found that when a small proportion of firedamp, less than that contained in the return airways of practically every fiery mine, was added, the resulting mixture could be ignited by means of a naked light, and continued to burn with a dark yellow, smoky flame so long as coal-dust and firedamp were supplied to the current. This discovery proved to my entire satisfaction that coal-dust, although consisting of solid particles, played exactly the same part as a combustible gas when disseminated in the air—could, in fact, be substituted for firedamp, and did not require the extraneous heat of a firedamp flame, as imagined by Faraday and Lyell, "to distil coal-gas from it." So far as I was personally concerned, the question was solved then and there; that is to say, I had no longer a shadow of doubt that coal-dust played the principal, and firedamp only a subordinate, part in all great explosions; or, again, that coal-dust played the part that had been assigned to "outbursts of gas" by the colliery explosion experts and inspectors of mines of that day and of many previous years.

In December of the same year, when an explosion, by which seventeen men lost their lives, occurred in a dry and dusty district in Llan Colliery, near Cardiff, I made a careful study of all the circumstances, attended the inquest, and gave evidence[2] to the effect that in my opinion coal-dust had been the paramount factor in the explosion; that the coal-dust had been swept up from the floor, mixed with the air, and ignited by the explosion and flame, respectively, of a comparatively small volume of firedamp, and that this gas had itself been accidentally ignited by a naked light.

At the same time I made some further experiments with coal-dust, as well as another series to determine the height of the firedamp cap corresponding to various mixtures of air and firedamp containing carefully measured proportions of each (a subject that had not been previously investigated). I then prepared a paper entitled "On the Influence of Coal-dust in Colliery Explosions," and through the late Dr. Frankland presented it to the Royal Society, by whom it was published in the following March (Proc. Roy. Soc., vol. xxiv., p. 354).

Early in 1876 Mr. (now Sir Henry) Hall carried out his celebrated experiment with a blasting shot, and published an account of it in June of the same year; two years later Prof. Marrecco and Mr. Morison, and four years later Sir Frederic Abel, made experiments with coal-dust, and in 1886 the two inspectors of mines Messrs. W. N. (now Dr.) and J. B. Atkinson published a book describing explosions in certain mines in their respective districts, which they attributed to coal-dust.

Owing chiefly, as can now be fully appreciated, to the small proportions of volatile matter contained in the two kinds of coal-dust with which my experiments were made (about 16·5 per cent. and 18·5 per cent. respectively), and partly, no doubt, also to the swiftness of the air-current necessary to sustain it in suspension in the apparatus, I had not up to this point proved that a mixture of air and coal-dust, at ordinary pressure and temperature, could be ignited by means of a naked light. On the other hand, I had proved that, when less than 1 per cent. of firedamp was added to such a mixture, it could be so ignited, and continued to burn like a large jet of inflammable gas. Again, at p. 369 of my first paper I stated the opinion that "if coal-dust could be made fine enough, and were thoroughly mixed with dry air in the proportion of about one pound to 160 cubic feet of air, the mixture might at least be so nearly inflammable" (at ordinary pressure and temperature) "that an explosion begun in it in a confined space," like the workings of a mine, "might be propagated through it"; and, further, on September 7, 1878, I said, in *Iron*:—

"It must not for a moment be supposed by anyone who has perused the foregoing pages that because I have only spoken of mixtures of air and coal-dust, or of air, coal-dust, and firedamp, as forming feebly explosive mixtures, I mean to imply that they cannot produce any, or all, of the results observed in the most destructive explosions that have ever been witnessed. I have constantly made use of the qualifying expression "*at ordinary pressure temperature*," thereby signifying that their behaviour at extraordinary pressure and temperature, such as are brought into play when an explosion is begun in a confined space, like the interior of a mine, may be, and probably is, very different." "That they do behave very differently has long been my settled conviction. . . ."

I entertained no doubt in my own mind as to what result would follow the initial stage, but in laying the question before the Royal Society and others I could not go beyond proved facts, and hence the necessity of approaching it hypothetically in my first paper, as follows (*loc. cit.*, p. 354):—

"If it could be shown . . . that a mixture of air and coal-dust is inflammable at ordinary pressure and temperature there would be no difficulty in accounting for the extent and violence of many explosions which have occurred in mines in which no large accumulations of firedamp were known to exist; for it is only necessary to suppose that a sudden gust of wind (originated, for example, by the explosion of a small accumulation of firedamp) had swept through the adjoining galleries, raising a cloud of dust into the air, and then all the other phenomena would follow in regular order. The flame of the originally inflammable mixture would pass directly into the newly formed one, expanding its volume; the disturbance would be propagated over an ever-widening area until that area might possibly become co-extensive with the workings themselves; and the consequences would be the same as if the whole space had

[1] Abridged from the Presidential Address delivered to the South Wales Institute of Engineers on January 18 by Prof. W. Galloway.

[2] Published *verbatim* in the *South Wales Daily News* of December 22, and *Western Mail* of December 23, 1875.

been filled with an inflammable mixture before the disturbance began."

It was demonstrated a few years later (Proc. Roy. Soc., No. 219, p. 437), by means of a larger apparatus built at Llwynpia Colliery with funds provided by the Lords of Committee of Council on Education, at the instance of the Royal Society, that a mixture of air and coal-dust from the same sources and of the same quality as that which had been used in my first experiments was inflammable at ordinary pressure and temperature. The cloud of coal-dust thrown out of that apparatus into the open air, in some instances from 30 to 50 feet long by from 10 to 15 feet in diameter at its widest part, was permeated with rolling flames in identically the same manner as, although on a smaller scale than, the corresponding clouds ejected from the larger apparatus at Altofts and Liévin.

It might have been expected that this final proof would have settled the question definitely; but, as its subsequent history shows, the number of those who began to discuss it has been so great, and their opinions so diverse, that but little progress has been made during the thirty years that have since elapsed.

The object of my experiments was to elucidate the causes of great colliery explosions. They were a means to that end, and nothing more. For it appeared to me that if once the causes were known a means of prevention would be easily discovered, but that, so long as explosions continued to be attributed to outbursts of gas, which could neither be foreseen nor prevented, the safety lamp would be looked upon as the miners' only shield against a constantly threatening danger.

Proneness to attribute all explosions to firedamp was the real stumbling-block to progress. It held the French engineers and many others in bondage for thirty-one years after 1875, and was only finally and effectually removed by the occurrence of the Courrières explosion and the sensational phenomena subsequently revealed in the experiments at Altofts and Liévin.

After arriving at the conclusions narrated above, I sketched out in another article, which was published in *Iron* in 1878, what appeared to me to be two necessary additions to the Coal Mines' Regulation Act, as follows:—

(1) "No shot must, on any pretence whatever, be fired in a dry mine until the floor and sides of the working place, or gallery, in which it is situated have been drenched with water, and rendered artificially damp, to a distance of at least 15 yards from the shot-hole."

(2) "In every naturally dry mine water shall from time to time be sprinkled on the roadways, and in the neighbourhood of the working places, in sufficient quantities to render them damp at all times, both by night and day."

In 1886 the first of these two rules was adopted in the Coal Mines' Regulation Act, 1886–7, but 20 yards was specified instead of 15; the second was voluntarily adopted almost immediately in many mines in South Wales and elsewhere, and was made compulsory by the Prussian Government in 1899–1900, but is not insisted on by the law of this country.

I can still conceive of no better safeguard against the dangers of shot-firing than that of rendering the dust harmless with water in the manner now specified in the Coal Mines' Regulation Act, provided it be properly carried out. As regards the second precaution, I am now of opinion that universal watering might be safely dispensed with if a zone of wet ground of adequate breadth were created round about every accumulation of explosive gas or every point at which such an accumulation is liable to occur in open spaces near the working places or accessible to the workmen.

Although French engineers had taken a prominent part in the assigning of a certain *rôle* to coal-dust thirty or forty years ago, they rejected the coal-dust theory from the first, and continued to oppose it until within the last few years, concentrating the whole of their attention, as M. Taffanel tells us, upon discovering the best means of dealing with firedamp. As an indication of their attitude, I may quote the words of M. H. Le Chatelier, who, writing in 1890 regarding the three supposed special causes of explosions, viz. barometric variations, coal-dust, and outbursts of gas, expressed himself as follows:—

"The first is purely imaginary, the second is insignificant in the absence of explosive mixtures of firedamp and air, the third alone is really serious, but happily it occurs only under very exceptional circumstances."[3]

It is remarkable, therefore, that the sudden blow which eventually shattered this opposition and brought the coal-dust question into world-wide prominence, namely, the great disaster at Courrières Colliery in 1906, in which more than 1100 men perished, should have fallen upon France herself. The effect was immediate; commissions and committees were hastily called together or revived, thousands of pounds were forthcoming for experiments, apparatus on a comparatively gigantic scale was erected in England, France, and the United States, and experiments were resumed in an artificial gallery in Austria that had been disused for several years.

In the midst of this great awakening in the coal-mining world, the Mines Department of the Prussian Government, which formulates and promulgates the laws governing the safety of the Westphalian coal mines, remained apparently unmoved.

In 1884 the Prussian Firedamp Commission made experiments with coal-dust on a fairly large scale in an artificial gallery at Königsgrube, Saarbrücken, some of which were seen by Lord Merthyr and myself on October 24 of that year. The dust employed in these experiments was collected from the floors of various collieries producing coal of different qualities, and as it was submitted to the test without having been sifted to remove the coarser particles and reduce it to a uniform degree of fineness, the different kinds naturally gave different results. As a consequence, the commission reported that although some kinds of dust produced explosive phenomena, and were therefore highly dangerous, others did not do so under the same conditions, and might, therefore, be considered safe. Acting under this impression, they recommended, first, a system of watering in a general way in dangerous mines; secondly, the use of brisant and short-flaming explosives in place of gunpowder in all dusty mines; and, thirdly, the thorough damping of the dust for a distance of at least 10 metres in front of every blasting shot.[4]

Soon after the completion of the experiments water-mains were laid in the Saarbrücken mines, which belong to the Prussian State,[5] and later some of the large Westphalian mines began to follow their example; but very little was done in this direction until after the occurrence of a disastrous explosion at Carolinenglück Colliery on February 17, 1898, by which 116 men were killed.

Experiments with shots charged with gunpowder on the one hand, and with brisant explosives on the other, in the presence of inflammable gas and coal-dust, were begun more or less simultaneously in Germany, France, and other Continental countries, and in England both with brisant explosives and water-cartridges, early in the nineteenth decade of last century. I had the honour of conducting those carried out in this country during a period of several years, with the collaboration of Lord Merthyr, who was a member of the Royal Commission on Accidents in Mines, under the auspices of which they were made.

As the result partly of the voluntary, partly of the legislative, action taken in this country, it will be seen from the following table that there has been a marked diminution in the number of deaths from explosions during the last thirty years, notwithstanding the increase of more than 50 per cent. in the number of men employed and in the output of coal:—

Year, or Average of Period Named.

Period		Output	Men employed underground	Number of deaths
1 year ...	1851	— ..	— ...	321
1 ,, ...	1852	— ...	— ...	264
10 years ending	1862	— ...	— ...	216
,, ,, ,,	1872	128,680,321 ...	403,281 ...	238
,, ,, ,,	1882	168,921,705 ...	461,024 ...	263
,, ,, ,,	1892	203,322,840 ...	588,446 ...	147
,, ,, ,,	1902	250,940,800 ...	747,509 ...	104
9 ,, ,,	1911	— ...	— ...	134

[3] Le Grisou et ses Accidents, Extrait de la Revue Générale des Sciences pures et appliquées. No. 20, du 30 Octobre, 1890, p. 19.

[4] Hauptbericht der Preussischen Schlagwetter Commission, p. 221 (1887.)

[5] Die Entwickelung des Niederrheinisch-Westfälischen Steinkohlen-Bergbaues, vol. ii., p. 6 (1904).

The high average of the last period of nine years is due to the occurrence of two great explosions, admittedly of coal-dust, in which 480 men were killed. To my personal knowledge these two explosions might have been avoided had ordinary precautions been taken of the kind referred to above. But for these two explosions the average of the last nine years would have been 80 instead of 134, or the lowest on record for sixty years.

In the United States, the greatest coal-producing country in the world, the coal-dust question attracted scant attention until 1907, when the total death-roll from coal-dust explosions, so-called "windy shots," and gunpowder explosions reached the appalling figure of 1148.

In 1908 Congress was induced to vote a sum of money for the investigation of mine explosions; the Geological Survey was entrusted with the work, and on December 3 of the same year a testing station that had been built at Pittsburg during the interval was formally opened.

The recent experiments have corroborated the announcement made many years ago that an explosion capable of propagating itself through the workings of a mine cannot be initiated unless the cloud of dust and air is both large dense, and is ignited by a flame preceded by an air-wave.

The quantity of dust ordinarily in the air, or raised by the passage of a train of mine waggons, however rapidly they may be moving, is far too tenuous to be in the slightest degree inflammable.

M. Taffanel states[6] that the minimum quantity of the very highly inflammable coal-dust employed in his experiments that must be suspended in still air before the mixture can be ignited by a large flame like that of a comet lamp is 1 lb. to 80 cubic feet; that the probability of a dust-cloud of that density being formed in any mine working under normal conditions is extremely feeble; and that even "in working places called *very dusty* or *smoking* the density does not exceed more than a few grams per cubic metre" (say, one-third of an ounce in 80 cubic feet, or about one-fiftieth of that required to render the mixture inflammable).

I mention these facts in order, if possible, to counteract the exaggerated notions that have sometimes of late been expressed regarding the dangerous nature of coal-dust even in a state of quiescence, some persons seeming to credit it with qualities akin to those of gunpowder.

The relative fineness of the dust, proportion of volatile matter contained in it, and quantity present per unit of length in the experimental gallery determine the velocity of the flame and the pressure attained by the explosion at any point. When all three conditions are favourable the velocity and pressure increase rapidly with the distance traversed, and if the distance is sufficiently great the pressure is liable to burst the gallery, as it did in one or two instances—at Altofts and Liévin. As the dust for experiments is prepared mechanically from pure coal, and may be made far finer than the average of that found in any colliery, it follows that the velocity and pressure of explosions in the artificial galleries may be, and no doubt in many cases are, far greater than those that occur in an explosion in a dry and dusty mine, for in the latter the dust swept up by the airwave which precedes the flame contains a mixture of coarse and fine particles of both combustible and incombustible matter. But the coarse particles of both and the fine particles of incombustible matter reduce the temperature of the flame, and, consequently, both its velocity and pressure must necessarily be reduced in a corresponding ratio.

It is recognised, then, that the conditions under which experiments are made in an artificial gallery are not quite the same as those which obtain in a mine, and that the results observed in the one case may be essentially different in many respects from those experienced in the other. Hence it arises, probably, that although experiments have been assiduously carried on in artificial galleries for several years, no distinct pronouncement has yet been made as to the best means of either preventing or arresting explosions.

The Altofts gallery has been lent to a joint committee consisting of the original committee of colliery owners and members of the Royal Commission on Mines, which is stated to be about to undertake further experiments; M. Taffanel, who conducts the experiments for the French colliery owners, continues his experiments, and has sketched out a programme for many more; the Austrian investigators have made experiments with mixtures of coal-dust and cement-dust, with watered zones, and with what they designate water-curtains, which have not given satisfactory results; and, lastly, the experiments at the Pittsburg gallery have been only of a preliminary character so far as described up to the present, and have shed no particular light on the subject.

So far, then, no finality has yet been arrived at, and all the investigators have intimated that they have many more experiments still to carry out. But since these experiments were begun, and since the dangerous nature of coal-dust has been publicly demonstrated by their means, two explosions, fit to take rank with the most disastrous of last century, have occurred in this country, showing that the demonstrations have been futile so far as stimulating spontaneous action on the part of some managers to take even ordinary precautions is concerned. Partly for this reason, and partly because we may have to wait for some years longer before the investigators arrive at a unanimous decision as to what they think ought to be done, it would perhaps be well in the meantime to adopt a course that would undoubtedly have the effect of vastly reducing, if not entirely eliminating, the risk of explosions, both in damp and dry mines, by establishing three simple rules of the following import:—

(1) That in all dry mines the dust within the radius of a shot-hole now specified by the Coal Mines Act be damped *with sprinklers attached to a water-main*. (I am of opinion that the distance of 20 yards from the shot-hole, within which the dust is required to be watered according to the existing law, is unnecessarily great, and that with the short-flaming explosives and water-cartridges now in use a distance of 10 yards is ample.)

(2) That in all dry mines the dust be damped within a certain minimum radius of every accumulation of inflammable gas, or place in which the air shows a cap of one-quarter of an inch or upwards in height, by the same means as those mentioned in the first case.

(3) That all work be prohibited in both damp and dry mines within a certain minimum radius of every accumulation of inflammable gas, or place in which the air shows a cap of more than one-quarter of an inch in height, excepting only that required for the removal of the accumulation, or foul air, respectively.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Coal Owners' Associations of the South Midland district, realising that rescue work in mines is a subject in connection with which research is desirable, have arranged with the University for the appointment of a lecturer in mine rescue work. The stipend of the lecturer will be defrayed by the Coal Owners' Associations, the amount offered being 250*l*. per annum. The functions of the lecturer will be not only to give lectures and instruction in the subject at the University, but also to be responsible for the organisation of rescue work, and to superintend the equipment and training of rescuers throughout the district.

Mr. John Furneaux Jordan has been appointed Ingleby lecturer for the current year.

LONDON.—The report of the Royal Commission on University Education in London, recommending a central building for the University, to which we referred in an article published in NATURE (January 4), has already produced an important scheme for the acquisition of a vacant site of more than 100,000 square feet immediately behind the extension of the British Museum. The site consists of four plots, two on each side of the new British Museum Avenue, on one of which it is proposed that a spacious hall should be built for the University, the other three plots being used for administration, library, small lecture theatres, rooms for graduates, and headquarters of the Officers Training Corps. The site is part of the Bedford estate, and it is stated that the Duke of Bedford is pre-

[6] Cinquième Série d'Essais sur les Inflamma ions de Poussières, Août, 1911, p. 68.

pared to dispose of it for the purposes suggested. Apparently the scheme had not at the time of its publication received the approval of the Senate of the University, and has been launched in anticipation of that approval and of support from wealthy benefactors of the University. The site is central in position and adequate in area, while its proximity to the British Museum is obviously a great recommendation.

OXFORD.—Prof. W. Odling, F.R.S., has sent the Vice-Chancellor a formal intimation of his resignation of the Waynflete professorship of chemistry, to take effect from the end of Trinity term, when he will have completed forty years' tenure of the office.

DR. E. T. WHITTAKER, F.R.S., Royal Astronomer of Ireland, has been appointed professor of mathematics in the University of Edinburgh, in succession to the late Prof. Chrystal.

MR. CLEMENT STEPHENSON has offered a gift of 5000*l.* to the Armstrong College, Newcastle, towards the proposed building for the new agricultural department of the college for advisory work among farmers in the north-east of England. The scheme of the department has been planned at the invitation of the Board of Agriculture, and the gift has been accepted with the cordial thanks of the council of the college.

THE University of St. Andrews has decided next July to confer the honorary degree of LL.D. upon Prof. G. F. L. P. Cantor, professor of mathematics at the Friederichs University, Halle; Prof. G. G. Henderson, professor of chemistry in Glasgow Technical College; Prof. J. P. Kuenen, of Leyden, formerly professor of physics in University College, Dundee; and Sir John Batty Tuke, who for many years represented the Universities of Edinburgh and St. Andrews in Parliament.

THE Central Technical College Old Students' Association appeals for subscriptions for a memorial to Prof. Ashcroft, who died suddenly on December 14, 1911. It is proposed to place a tablet to his memory in the college, and to assist his son, who is now about fourteen years old, to follow and complete the course of training which Prof. Ashcroft had planned for him. Donations should be addressed to Dr. E. F. Armstrong, 98 London Road, Reading, if possible before the end of this month.

HIS MAJESTY THE KING has been pleased to direct that the Glasgow and West of Scotland Technical College shall henceforth be known as "The Royal Technical College, Glasgow." This new title will fittingly commemorate the visit paid by King Edward to the college when he laid the memorial stone of the new buildings in May, 1903. The buildings are now complete, and contain about seven acres of floor space. Their cost, together with site and equipment, amounted to more than 360,000*l.*, all of which sum, except about 90,000*l.* from the Scottish Education Department, was provided by voluntary donations. Last session there were 536 day students and 4842 evening students in attendance, while the continuation classes in science affiliated to the college, and extending throughout the six surrounding counties, contain more than 8600.

WE learn from *The Sydney Morning Herald* that three new chairs are to be established at the University of Sydney in consequence of the additional vote for the work of the University sanctioned by the Legislature. The new professorships deal with botany, applied chemistry, and economics. The chair of botany is required for the agricultural curriculum. With regard to the chair of organic and applied chemistry, it has long been felt to be desirable that organic chemistry and its various applications to the products of the country should be fully taught. The Government has also given the University a liberal grant to assist the library, and has made a grant for this year for the provision of apparatus for the medical faculty and for the engineering department. The sum of 2500*l.* has been set apart for the extension of the departments already existing in the University, in addition to a vote to assist in providing retiring allowances for old officers of the University when the time comes that they are no longer able to perform their duties.

THE programme for the Congress of the Universities of the Empire, to be held in London this year, has now been published. On the morning of July 2, Lord Rosebery, Chancellor of the Universities of London and Glasgow, and Lord Rector of the University of St. Andrews, will take the chair, and the subjects for discussion will be:—(1) question of specialisation among universities; (2) inter-university arrangements for post-graduate and research students. On the morning of July 3, Lord Curzon of Kedleston, Chancellor of the University of Oxford, will preside, and (1) the relation of universities to technical and professional education and to education for the public services, and (2) interchange of university teachers, will be discussed. During the afternoon of the same day the subject will be the problem of the universities in the East in regard to their influence on character and moral ideals. At the morning session on July 4, Lord Rayleigh, Chancellor of the University of Cambridge, will preside, and the subjects discussed will be:—(1) conditions of entrance to universities and the mutual recognition of entrance tests; (2) action of universities in relation to the after-careers of their students. In the afternoon the chairman will be Lord Haldane, Chancellor of the University of Bristol, and the subject of university extension and tutorial class work will be introduced. At the concluding session on July 5, Lord Strathcona and Mount Royal, Chancellor of the Universities of Aberdeen and McGill, will preside, and the subjects will be:—(1) the establishment of a Central University Bureau: its constitution and functions; (2) the position of women in universities.

AT the annual dinner of the Court of the University of Leeds, Lord Haldane was the principal guest. In responding to the toast of "The Visitors," he dealt, among other important matters, with the application of science to industry. Lord Haldane said, we learn from *The Times*, that the biggest men are those who can seize rapidly on the ideas which science gives and transform them into practice. This is one of the things we have learnt from the great German nation, which in this matter has set an example to the whole world. But we never can do the best merely by copying, and we have to work out things according to our nationality and individuality. England is working to-day on some very remarkable lines of her own. In Germany one is struck by the enormous number of students of the middle classes in the universities and the great technical institutes. Here we have done something else. We may be behind in some things, but in one thing we are ahead of the rest of the world, and that is the way in which we have brought the influence of university life to bear upon the best brains in our artisan classes. The system of evening instruction, which is distinctive of our newer universities, is a very extraordinary system, and it fits in well with the remarkable aptitude of our workmen for producing, if only they get the chance, a quality of goods which is at least equal to the quality produced by any other workmen in the world. Add science to the top of that, and we need not be afraid. Although our universities may find it a burden to carry, they are doing the greatest service to the State by the splendid part they play in extending the influence of learning to the artisan classes.

THE current issue of *The Empire Review* opens with an article on the Imperial College of Science and Technology, by Sir Alfred Keogh, K.C.B., rector of the college. An excellent account is provided of the progress of the college during the last three years. The greatest demand upon the resources of the governors has been for buildings. As a consequence of the change in methods, the old buildings occupied by the Royal School of Mines, the Metallurgical and Geological Departments, have been abandoned, and new buildings are now approaching completion. The new laboratories represent the best obtainable, and to maintain a close connection between industrial opinion and academic methods, the Institution of Mining and Metallurgy has been asked to form an educational advisory board, and has consented to act as referees whenever doubt or difficulty may arise. In the case of the City and Guilds College, the task of the governing body has been easy, and their efforts have been limited to the development of advanced engineering in new premises.

Great attention has been given to the development of the botanical departments, the work of which is directed largely towards the specific demands of the vegetable industries, whether at home or abroad. Great progress has been made and a demand has arisen for a new building to house two new departments, one dealing with the technology of woods and fibres, the other with physiology and pathology, and the governors have authorised its erection and equipment. Similarly, the School of Zoology has been extended and developed in many new ways, and has become the resort of many advanced students. Soon, too, it is hoped to call into being a great department of chemical technology. In fact, Sir Alfred Keogh has to record a gratifying account of strenuous endeavour on the part of the authorities, succeeded by an immediate and remarkable success.

PROF. W. C. UNWIN, F.R.S., president of the Institute of Civil Engineers, was the guest of the evening at the fourteenth annual dinner of the Old Students' Association of the Central Technical College, held on Saturday, February 10. Mr. W. Duddell, F.R.S., occupied the chair, and was supported by a very representative gathering of about 180 old Centralians and their friends. The guests included Sir John Wolfe Barry, K.C.B., F.R.S.; Sir Wm. White, K.C.B., F.R.S.; Profs Armstrong, Dalby, Klugh, and Mather, from the City and Guilds College; Prof. S. P. Thompson, of Finsbury Technical College; and Prof. H. McLeod, a former colleague of Prof. Unwin's at Coopers Hill. The toast of Prof. Unwin was proposed by the chairman, who emphasised his services to the Central Technical College, to education, and to engineering, and read letters and telegrams of congratulation received from old students in all parts of the world. Mr. H. A. Humphrey, one of the first and most distinguished of Prof. Unwin's students, seconded the toast, after which a presentation was made to Prof. Unwin. In replying, Prof. Unwin gave some account of his career, and more particularly of the early days of the Central. He laid stress on the high standard of knowledge at entry required for their matriculation examination, and the value of the training given by the complete course; he regretted the interference with this course which the submission to the London University examinations had entailed. Sir John Wolfe Barry, who is to be the next president, proposed the association in appropriate terms, emphasising the value of such organisations. In reply, Dr. E. F. Armstrong referred to the fact that the membership was approximately 1000, and stated that they were there that evening, not only to do homage to their former professors, but also to honour those members of the City and Guilds Institute who by great expenditure in time and money had founded and maintained the college of which they were all so proud.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, February 6.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Mrs. Rose Haig **Thomas**: A breeding experiment with pheasants. The experiment was undertaken to confirm a previous one, in which it had been observed that a male pheasant had transmitted to his F 2 ♀ offspring the female plumage of his species. The following cross produced the same result:—

Phasianus formosus ♀ × *Phasianus versicolor* ♂.

F 1 ♀ × *P. versicolor* ♂.

F 2 ♀ ♀ ♀ ♀ ♀ ♂ ♂.

The five hens hatched in F 2 had grown up, and were all *versicolor* in pattern, colour, dimensions, and moral character. One of these hens had been kept to breed with to test her purity, and the skins of the other four were exhibited, together with the skins of a *Ph. formosus* ♀ and a *P. versicolor* ♀ for comparison. The results of these two experiments did not appear to conform to [...] theory that the cock was homozygous for sex ♂♂. Th[...] experiments had also shown that the male had not tr[...]mitted to his female F 2 offspring such constant purity [...] male plumage. In the first experiment, Silver × Swinh[...] out of four males three were "Si. Sw.," one only pu[...] "Sw.," and the only two males that lived in the seco[...] experiment, *formosus* × *versicolor*, were both "Fo. Ve."—J. T. **Cunningham**: Mendelian experiments on fow[...] The paper described the characters of ten individuals [...] the F 2 generation reared from a pair of F 1's produc[...] by a cross between Silky ♀ × Bankiva ♂ made by M[...] D. Seth-Smith. The characters recognised were seven [...] number, namely, colour of plumage, character of plum[...] (whether silky or normal), comb, pigmentation of skin a[...] internal tissues, toes (*i.e.* presence or absence of ext[...] toe), feathering of legs, crest on head. The Silky of t[...] original cross had white "silky" plumage, rose com[...] crest on head, double hallux, feathered legs, and bla[...] pigmented skin. The Bankiva had black-red plumage [...] normal structure, single comb, unfeathered shanks, nor[...] toes, and normal unpigmented skin, no crest. T[...] dominant characters in the F 1 were coloured plumage [...] normal structure, rose comb with crest, pigmented ski[...] feathered legs, and double hallux, but several of th[...] characters showed irregular dominance or intermedi[...] condition. The most important results recorded in [...] paper were imperfect segregation in the F 2 generation [...] at least two of the characters, namely, the absence [...] pigmentation in the plumage and the absence of pigment[...]tion in the skin and tissues. The recessive white of t[...] plumage occurred in four individuals, in all of which, [...] especially in one, some pigment was present. Only o[...] specimen apparently recessive with regard to the abs[...] of pigmentation in the skin had been examined *p[...] mortem*, and in this unmistakable traces of pigmentati[...] in the skin and peritoneum were observed.—J. L[...] **Bonhote**: A further collection of mammals from Egy[...] received from Captain S. S. Flower. The communicat[...] dealt with some twenty species, of which the follow[...] two were described as new:—*Meriones crassus pallid[...]* from Atbara, Sudan, similar to *M. crassus sellysii*, fr[...] which it differs in its larger size, paler coloration, a[...] more pointed snout. *Acomys russatus aegyptiacus*, fr[...] the desert near Cairo. A race of *A. russatus*, from wh[...] it differs in its smaller size and much yellower colorati[...]—H. Wallis **Kew**: The pairing of pseudoscorpiones. T[...] paper was based on observations made by the author [...] living specimens of *Chelifer* (*Chelifer*) *latreillii*, Leach, [...] *Chelifer* (*Chernes*) *cyrneus*, L. Koch.

PARIS.

Academy of Sciences, February 5.—M. Lippmann in t[...] chair.—C. **Moureu** and Amand **Valeur**: The question [...] the symmetry of sparteine. Details of the properties of t[...] hydriodides and iodomethylates of sparteine. There is [...] proof of the two nitrogen atoms in this alkaloid b[...] symmetrical, and the stereoisomerism of the two spart[...] iodomethylates is proved.—A. **Lacroix**: The volcanoes [...] central Madagascar. The *massif* of Itasy.—E. **Vallier**[...] The present position of the ballistic problem.—S. **Pozzi**[...] Some cases of ossification of the ovary.—Henri **Parenty**[...] A temperature regulator of precision. The instrum[...] described by E. Esclangon in a recent number of [...] *Comptes rendus* was anticipated by MM. Parenty [...] Bricard in 1896.—A. **Perot**: The wave-length of the [...] line D_1. The results of the application of the interf[...] method to the study of the line D_1. A curve is g[...] showing the increase of the wave-length as a function [...] the distances from the centre along a line N.-S.—G. [...] **Tikhoff**: The photographic registration and reproduc[...] of the twinkling of the stars. A photograph is taken [...] the spectrum of the star by means of a prism objectiv[...] uniform movement perpendicular to the length of [...] spectrum being imparted to the sensitised plate. In [...] case of Sirius, the changes of intensity of different r[...] are usually independent of each other, whilst in the c[...] of the planet Venus all the rays change simultaneously[...] M. **Tzitzéica**: The Laplace equations with quadr[...] solutions.—Henri **Lebesgue**: The problem of Dirich[...]—G. **Cotty**: A class of quadratic forms with four varia[...]

connected with the transformation of Abelian functions.—Gabriel **Sizes**: The multiple resonance of bells. Details of the harmonics given by the four principal bells of Montpellier Cathedral.—E. **Besson**: The condensation of water vapour by expansion in an atmosphere of carbonic acid. The experiments were recorded photographically. Condensation commenced for expansion between 1·30 and 1·32; if the gas was previously ionised by exposure to the Röntgen rays for two seconds, the condensation appeared a little sooner. The importance of removing all traces of air in these experiments is emphasised.—L. **Verain**: The dielectric constant of carbon dioxide in the neighbourhood of the critical point. The results of measurements of the dielectric constants of liquid and gaseous carbon dioxide for temperatures between $-4°$ and $30°$ C. are shown graphically. The constant varies between 1·00 and 1·60, the experimental error being under 0·05. At 31·4° C. the values for the gas and liquid become identical.—G. **Urbain**: A laboratory balance with electromagnetic compensation for the study of systems giving off gas with a sensible velocity. The final adjustment of this balance is made by altering the intensity of an electric current in a solenoid acting upon a small magnet suspended from one of the beams. The balance described had a maximum load of 0·1 gram and a sensibility of 0·01 milligram.—Marcel **Boll**: The application of the electrometer to the study of chemical reactions in electrolytes.—E. **Baud**: A general law of solution.—Pierre **Achalme**: The *rôle* of the inter-atomic electrons in catalysis.—A. **Seyewetz**: The preparation and properties of a silver oxybromide. This oxybromide is prepared by the action of an aqueous solution of benzoquinone containing potassium bromide upon finely divided silver, and purifying the crude product by crystallisation from hot ammonia solution. The analyses correspond to Ag_7Br_7O.—A. **Guntz** and M. **de Greift**: Copper amalgam. The properties of the amalgam depend on whether it has been prepared in the cold by electrolysis or by heat. The former leaves the amalgam HgCu when submitted to great pressure; the latter, under similar treatment, leaves nearly pure copper.—G. **Vavon**: A method of preparation of the aromatic alcohols. The addition of hydrogen to the aromatic aldehydes in the cold under the catalytic action of platinum black gives high yields of aromatic alcohols. Numerous applications of the reaction are described, proving the method to be a general one.—V. **Grignard** and Ch. **Courtot**: Some new α-indene derivatives.—E. **Chablay**: The reduction of the amides and esters of the fatty series by the metal-ammoniums. The amides give the sodium derivative and the corresponding sodium alcoholate.—Louis **Ammann**: The influence of the extraction liquid upon the composition of the beetroot pulps from sugar works and distilleries. The residues from the sugar works are less valuable as cattle food than those from the distilleries, and this difference is mainly due to the nature of the liquid used in the extraction of the beet.—E. **Boullanger**: The action of flowers of sulphur upon vegetation. Small quantities of sulphur mixed with the soil have a favourable action upon the growth and yield of various plants.—A. **Berg**: The diastatic activity of the various organs of *Ecballium elaterium*. The physiological function of the pulp surrounding the seeds.—A. **Trillat**: The action of putrid gases upon the lactic ferment.—H. **Cardot** and H. **Langier**: The localisation of stimulations in the unipolar method.—J. **Thiroloin** and M. **Jacob**: Prolonged forms of experimental pancreatic diabetes.—L. **Grimbert** and J. **Morel**: The determination of the acidity of the urine. The calcium salts are removed from the urine by addition of potassium oxalate, and the ammonia determined and allowed for.—Gabriel **Bertrand**: The importance of manganese in the formation of the conidia of *Aspergillus niger*. In the absence of manganese the conidia of this mould are not formed. The amount of manganese required is extremely small.—M. **Javillier**: The influence of the suppression of zinc in the culture medium of *Aspergillus niger* on the secretion of sucrase by this mould. Aspergillus deprived of zinc allows no sucrase to diffuse into the culture medium nor into distilled water. The cells secrete sucrase, but the quantity is much less than when a trace of zinc is present.—J. **Dewitz**: Experimental apterism in insects.—Georges **Bohn**: Variations in sensibility in relation to the variations of internal chemical state.—E. **Vasticar**: The structure of the spiral membranous sheet of the slug.—M. **Fabre-Domergue**: The bacterial purification of oysters by treatment with artificial filtered sea water.—Louis **Calvet**: Remarks on the parasitic Bryozoa, *Watersia paessleri*.—L. **Joubin**: The cephalopods captured in 1911 by the Prince of Monaco.—L. **Sudry**: The importance and function of air-borne dusts.—G. **Grandidier**: A new example of the extinction of giant animal forms closely allied to existing species.—M. **Parvu**: The natural defence of rocks against the destructive action of the sea.

February 12.—M. Lippmann in the chair.—Ch. **Bouchard**: An optical sphygmo-oscillograph. A description of an optical arrangement designed to reduce, so far as possible, the inertia of the Marey sphygmograph.—M. De Launay was elected a member of the section of mineralogy in the place of the late A. Michel Lévy.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1911. Observations were possible on fifty-five days, and the results are given in tabular form.—Emile **Borel**: The fundamental theorems of the theory of real variable functions.—Jules **Drach**: The differential equations of geometry.—Federigo **Enriques**: The theorem of existence for algebraic functions of two independent variables.—A. **Lapresle**: The distribution of pressures and velocities in the disturbed region round a surface in a uniform current of air. The region was explored with the aid of a Pitot tube.—M. **Julhe**: The permeability to hydrogen of balloon envelopes. An additional layer formed of calico impregnated with a solution of gelatine in glycerine is placed inside the ordinary material. It prevents large losses of hydrogen.—Paul **Jégou**: The effect of secondary resonance in the receivers used in wireless telegraphy.—G. **Reboul**: Photochemical actions and photo-electrical phenomena. Ultra-violet light from a quartz mercury lamp was allowed to fall on a metal plate, and the emission of the negative charges studied.—Eugène **Bloch**: The use of photoelectric cells as photophones. An extension of the experiments of Bergwitz on the changes in the resistance of potassium by exposure to light.—Albert **Colson**: Methods of observation of the dissociation of nitrogen peroxide. Data are given for the dissociation pressures of nitrogen peroxide measured by three methods. These are compared with the dissociation phenomena observed for the same gas in chloroform solution, and it is shown that the results do not agree with the view that the dissolved and gaseous particles are identical.—M. **Dubrisay**: Chemical equilibria in solution. An experimental study of the reversible reaction between succinic acid and barium acetate.—H. **Baubigny**: Researches relating to the action of alkaline sulphites on copper salts. It is proved that a dithionate is formed when copper sulphate is acted upon by an excess of alkaline sulphite.—Eyvind **Boedtker**: Some menthone derivatives. A proof of the constitution of the derivatives obtained by the interaction of benzylidene-menthone and alkylmagnesium bromides.—H. **Gault**: The lactonisation of the α-ketonic esters.—H. **Cousin**: The action of bromine and chlorine upon dehydro-dicarvacrol.—G. **Malfitano** and Mlle. A. **Moschkoff**: The formation of dextrine from starch by drying. Starch placed in a vacuum over phosphorus pentoxide was found to become increasingly soluble in water. This is attributed by the authors to the formation of dextrin, and regarded by them as evidence that in the starch particles water serves as a link between the $C_6H_{10}O_5$ molecules.—E. **Bodin**: The purification of oysters in filtered artificial sea water. The author's experiments confirm those of Fabre-Domergue on the possibility of purifying oysters by artificial storage without commercial depreciation.—E. **Rouquette**: The sterilisation of drinking water by the action of ozonised oxygen and chlorine compounds in the nascent state. The simultaneous action of sodium bisulphate, hydrogen peroxide, and bleaching powder is suggested. The complete sterilisation of the water is shown to be rapid, the residual salts are harmless and very small in amount, and the cost is not excessive. It is of special service in cases of urgency.—A. **Magnan**: The cæcum in mammals. In previous papers the author has shown the relation between the length of the cæcum and the nature of the food in birds. It is shown that a similar relation holds in mammals.—Mieczyslaw **Oxner**: Experiments on the faculty of learning in the marine

fishes, *Coris julis*. A small piece of coloured paper was suspended on a line above a baited hook. The fish learnt to associate the hook with the paper, as after being twice caught on successive days, it refused the bait when the paper was attached, but took it when the paper was removed.—F. **Kerforne**: The tectonic of the region south of Rennes.

BOOKS RECEIVED.

Calcul et Construction des Alternateurs Mono- et Polyphasés. By Prof. H. Birven. Translated by P. Dufour. Pp. 179. (Paris: Gauthier-Villars.) 6 francs.

Théorie de la Couche Capillaire Plane des Corps Purs. By Dr. G. Bakker. Pp. 95. (Paris: Gauthier-Villars.) 2 francs.

Organisation et Direction des Usines. D'après de livre allemand intitulé "Der Fabrikbetrieb" de A. Ballewski. By A. Mayer. Pp. vi+220. (Paris: Gauthier-Villars.) 7.50 francs.

Kant's Gesammelte Schriften. Herausgegeben von der Königlich Preussischen Akademie der Wissenschaften. Band xiv. Dritte Abtheilung: Handschriftlicher Nachlass. Band i.: Mathematik-Physik and Chemie-Physische Geographie. Pp. lxii+637. (Berlin: G. Reimer.) 19 marks.

Ruins of Desert Cathay. Personal Narrative of Explorations in Central Asia and Westernmost China. By M. Aurel Stein. Vol. i. Pp. xxxviii+546+plates and map. Vol. ii. Pp. xxi+517+plates and maps. (London: Macmillan and Co., Ltd.) 2 vols. 42*s*. net.

Diesel Engines for Land and Marine Work. By A. P. Chalkley. With an introductory chapter by Dr. R. Diesel. Pp. xi+226. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Mineralogy. By F. Rutley. Eighteenth edition. Pp. viii+267. (London: T. Murby and Co.) 2*s*. net.

Vanished Arizona. Recollections of the Army Life of a New England Woman. By M. Summerhayes. Second edition. Pp. 319 (Salem, Mass.: The Salem Press Company.) 1.60 dollars.

Practical Chemistry for Engineering Students. By A. J. Hale. Pp. xvi+192. (London: Longmans and Co.) 3*s*. net.

An Experimental Course of Physical Chemistry. By Dr. J. F. Spencer. Part II. Dynamical Experiments. Pp. xvi+256. (London: G. Bell and Sons, Ltd.) 3*s*. 6*d*.

Solutions of the Exercises in Godfrey and Siddons's Solid Geometry. By C. L. Beaven. Pp. 164. (Cambridge: University Press.) 5*s*. net.

Examples in Arithmetic, Part I. Taken from A School Arithmetic. By H. S. Hall and F. H. Stevens. With Answers. Pp. vii+115+xxii. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

A.B.C. of Hydrodynamics. By Lieut.-Colonel R. de Villamil. Pp. xi+135. (London: E. and F. N. Spon, Ltd.) 6*s*. net.

The Gardener and the Cook. By L. H. Yates. Pp. x+260. (London: Constable and Co., Ltd.) 3*s*. 6*d*.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Variation of the Specific Heat of Water investigated by the Continuous Mixture Method: Prof. H. L. Callendar, F.R.S.—Index to Reports of Physical Observations—Electric, Magnetic, Meteorological, Seismological—made at Kew Observatory: Dr. C. Chree, F.R.S.—On the Velocities of Ions in Dried Gases: R. T. Lattey and H. T. Tizard.—The Observation by means of a String Electrometer of Fluctuations in the Ionisation produced by γ Rays: Prof. T. H. Laby and P. W. Burbidge.—The Wave Problem of Cauchy and Poisson for Liquid of Finite Depth and for Slightly Compressible Liquid: F. B. Pidduck.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Supply and Transmission of Power in Self-contained Road Vehicles and Locomotives: J. C. Macfarlane and H. Burge.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 9.—The Gyrostatic Compass and Practical Applications of Gyrostats: George K. B. Elphinstone.

PHYSICAL SOCIETY, at 5.—A Method of Accurate Comparison of Quantities of Radium: Prof. E. Rutherford, F.R.S., and Mr. Chadwick.—The Absorption of the γ-rays by Gases; Mr. Chadwick.—On Wave-form Sifters for Alternating Currents: A. Campbell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Works for the Prevention of Coast-erosion: W. T. Douglass.

SATURDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S

ESSEX FIELD CLUB, at 6 (at Essex Museum, Stratford).—Report on the Lichens of Epping Forest. II.: R. Paulson and P. G. Thompson.

MONDAY, FEBRUARY 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Economic Geography of the Tyne: A. J. Sargent.

ROYAL SOCIETY OF ARTS, at 8.—The Loom and Spindle: Past, Present and Future; Primitive Weaving Appliances: Prehistoric, Ancient, and Modern: L. Hooper.

INSTITUTE OF ACTUARIES, at 5.—On the Principle Provisions of the Law of Bankruptcy in England, with References to some Decisions of Interest to Life Insurance Companies: N. J. Carter.

TUESDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Optical Determination of Stress, and some Applications to Engineering Problems: Prof. E. G. Coker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Some Features of the West African Government Railways: F. Shelford.—*Probable Papers*: (1) Roller and Ball Bearings; (2) The Testing of Anti-friction Bearing Metals: Prof. J. Goodman.

WEDNESDAY, FEBRUARY 28.

GEOLOGICAL SOCIETY, at 8.—Late Glacial and Post-glacial Changes in the Lower Dee Valley: L. J. Wills.—The Glen Orchy Anticline (Argyllshire): E. B. Bailey and M. Macgregor.

ROYAL SOCIETY OF ARTS, at 8.—Education in Science as a Preparation for Industrial Work: H. A. Roberts.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, FEBRUARY 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Bacterial Production of Acetylmethylcarbinol and 2.3. Butylene Glycol. II: Dr. A. Harden, F.R.S., and Dorothy Norris.—An Instrument for Measuring the Distance between the Centres of Rotation of the Two Eyes: H. S. Ryland and B. T. Lang.—The Locomotor Function of the Lantern in *Echinus*, with remarks on other Allied Lantern Activities: Dr. J. F. Gemmill.—The Relation of Wild Animals to Trypanosomiasis: Capt. A. D. Fraser, R.A.M.C., and Dr. H. L. Duke.—The Transmission of *Trypanosoma nanum* (Laveran): Dr. H. L. Duke.—The Development of a Leucocytozoon of Guinea-pigs: E. H. Ross.

FRIDAY, MARCH 1.

ROYAL INSTITUTION, at 9.—The Total Solar Eclipse in the South Pacific, April, 1911: Dr. W. J. S. Lockyer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Masonry Dams: H. J. F. Gourley.

SATURDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, FEBRUARY 29, 1912.

THE PRINCIPLES OF WEATHER FORECASTING.

Forecasting Weather. By Dr. W. N. Shaw, F.R.S. Fully illustrated with maps, charts, and diagrams. Pp. xxviii+380. (London: Constable and Company, Ltd., 1911.) Price 12*s.* 6*d.* net.

THE text-book on "Weather" published by the late Hon. Ralph Abercromby in 1885 generalised the practice in forecasting which had gradually established itself in the Meteorological Office. The recognition in that book of types of pressure distribution associated with distinctive characteristics of wind, temperature, and rain, gave definiteness to the conceptions of cyclones, anticyclones, wedges, and V-depressions, and impressed on the minds of the last generation the dominance of atmospheric pressure over all atmospheric changes. Abercromby wrote with the enthusiasm of lively faith. He believed in cyclones and anticyclones as powers which made the weather—great, simple, and straightforward entities, the ways of which were almost fully known, and only a little additional knowledge required to make the prediction of weather definite and precise.

Recent meteorological researches at home and abroad have gradually involved meteorologists in an atmosphere of doubt as to the simplicity and the certainty of the relations of weather and pressure distribution. During his eleven years' labours as director of the Meteorological Office, Dr. Shaw has done much to initiate and encourage research into the problems most vital to weather forecasting, and the keenest anticipations have been formed as to the nature of the book now before us. In one way we are disappointed; Dr. Shaw has not attacked the Victorian certainties with the vigour of an iconoclast, nor proclaimed a finished system of new beliefs. He recognises the old ideas as idols, but he speaks of them respectfully, not crushingly. He adopts a deprecating tone, indeed, as of one who knows better, and insinuates the well-founded doubts which will enable every candid meteorological mind to recognise its latent idolatry and re-clothe the cyclonic Dagon or remove him quietly out of his place. The book is adapted for a transitional state of mind, ready to abandon the early ways as soon as the larger light is clear enough to make the new path plain, and that is the state of mind of all thoughtful meteorologists; hence it is suggestive rather than didactic, and stimulating rather than systematic. The main value of the work seems to us to lie in the definite formulation of the results of the recent researches carried on under the auspices of the Meteorological Office, and still in progress, researches which bid fair to reorganise the physical basis of weather study, and to make possible a real manual of weather forecasting at some future date. The actuality of the present book is its chief attraction, the reader being brought right to the front of advancing knowledge of weather conditions, and any defects it may possess are defects of that great quality.

Dr. Shaw, as we have hinted already, does not worship the conventional cyclone and anticyclone as the creators and controllers of weather; he shares Prof. Hann's view that these isobaric forms are themselves produced as incidents in the great streams of air which carry on the larger circulation of the atmosphere, and he leads towards the recognition of substantial air-currents of diverse origin flowing in various directions, meeting, and passing in various planes at different angles, as the true causes of weather. He treats moving air in accordance with the well-known principles of physics, and endeavours to establish the dynamical or thermodynamical antecedents of the meteorological phenomena concerned in weather. The work is one of immense difficulty; few men of science would have the courage to attempt it, and we are satisfied that no one having undertaken such a task could have carried it out in a more satisfactory way or with a more effective result than Dr. Shaw has achieved. In the introduction he makes much of the difficulty of the long-abused British units retained by English-speaking meteorologists in both hemispheres, and he outlines a modification of the C.G.S. system which would, he believes, greatly simplify research and exposition. He does not recommend the metric system as used by Continental meteorologists; but a derived system which has the high moral advantage of requiring to be learnt equally by our Continental friends and by ourselves, a sort of arithmetical Esperanto. Temperature is to be expressed in centigrade degrees, but from the absolute zero, so that ice melts at 273° and water boils at 373°. Pressure is to be expressed in fractions of the "C.G.S. atmosphere of 1,000,000 dynes per square centimetre," which corresponds to the normal pressure, not at sea-level, but at an altitude of 106 metres. The decimalisation of measures of time and arc are not suggested, so that the scheme lacks the roundness of theoretical perfection. In practice, so far as this book is concerned, the new system has superseded nothing, for the maps "on which," the author too modestly says, "the book is mainly dependent," are for the most part expressed in Fahrenheit degrees, inches, and Beaufort wind forces. We confess that we do not share Dr. Shaw's enthusiasm for the new system, but it is one of those matters in which the advice of Gamaliel can well be followed, and we do not raise a voice against it.

"Forecasting Weather" is treated in eighteen chapters, of which the first five deal with synoptic charts, the relation of winds to isobars, a statement of Abercromby's view of the order of weather-changes in a cyclone, which still holds good so far as the observed phenomena are concerned, types of weather, and local weather in relation to forecasting. All this is a development of what may be termed the conventional views in which most of us were brought up; but even here the development is very considerable. The question of winds and barometric gradient is happily treated, and the inclination of the wind to the isobars acquires a new significance from the demonstration that a wind moving in a circular path may alter its direction of motion without changing its velocity under the influence of a steepened gradient.

While Abercromby's view of cyclones still explains most of the appearances, Dr. Shaw is careful to point out that the old simple conception of the cyclone as a whirl of air inwards and upwards is not the only one possible, and that similar results would be yielded if the air in any part of the system performed no considerable portion of a complete revolution.

The next three chapters, on the physical processes of weather, the life-history of surface air-currents, and the minor fluctuations of pressure, are the most important in the book, for they are the embodiment of the researches made by the author and his assistants, and they are written with the freshness and conviction only possible when the facts dealt with have been won from the unknown by the narrator himself. Were one inclined to be critical one might perhaps hint that more space than is necessary for an account of weather forecasts is taken up by the curious paradox of cooling by warming, and the quantitatively insignificant condensation by mixing of air of different humidity. Such a criticism, if made, would probably be wrong, for it is precisely such cases which give force to the demonstrations of the great thermodynamical principles still imperfectly grasped by many meteorologists, though held as "fundamentals" from their youth up by the pupils of such men as Kelvin and Tait. Dr. Shaw is at his very best when unravelling the tangled skein of air-trajectories in the path of an advancing cyclone, and it is only when he comes to these chapters that a student unfamiliar with the papers in which the various researches were published can realise to the full how tenderly the author in the new light of his personal researches, which now appear for the first time in a text-book, has dealt with the prepossessions of the holder of the revolving-wheel theory of cyclones.

The old meteorologist must purge his sight of the image of the "revolving storm" if he is to understand what is, after all, the simpler statement of the onward sweep of vast air-streams on the margins or in the heart of which the various "disturbances" occur. Dr. Shaw proves to demonstration that we must view the normal condition of air as one of motion, not of rest, and that the temperate cyclones are disturbances of pressure carried along in the stream, not independent forms moving through normally still air. He shows also, as Hellmann in particular has done in his recent work on the Oder floods, that the isobars of a cyclone are not the simple flowing curves of the weather charts, but when mapped in greater detail, for smaller intervals of pressure, and from more stations of observation, they show a variety of "embroidery," as he happily puts it, and in that embroidery resides the explanation of most of the anomalies of the traditional cyclonic convention. We may perhaps be pardoned for hinting that some pertinent examples of the relation of rainfall to isobars might have been obtained if the maps of heavy rains in the pages of "British Rainfall" had been drawn upon; they are at any rate the most detailed instances of the mapping of precipitation. We are also a little sorry that the French terms, *ligne de grain* and *ruban de grain* are not translated and brought into intimate relation with the English *line-squalls*, the fine treatment of which is one of the best points of the discussion of the "embroidery," though were we to sample all the good points we might run some risk of an encounter with the law of copyright.

The remaining chapters, with one exception, deal with practical matters of forecasting as carried out in the London office. Important as they are, these do not carry the same load of scientific interest as the earlier portion, in which we see the rebuilding of meteorological theory as a house is rebuilt by the successive destruction and reconstruction of parts. The exceptional chapter is that on anticyclones, which is all new and of the utmost value. But for its name, which is apparently honoured for the sake of its godfather, the anticyclone would, we fear, be cast down from its high place, and proved to be a very ill-carved fetish. The beneficent purveyor of fine weather, the promoter of brilliant summer warmth and glorious winter cold is, in fact, shown up as an isobaric fraud. The anticyclone is now declared not to be a region of dry, descending air, not to be a focus of winter cold, not to be the country of origin of outward-moving air-currents, not even to be a distinctive meteorological entity. Quoting from his "Life History of Surface Air Currents," Dr. Shaw says:—

"Further evidence in favour of regarding anticyclones as masses of air which for some reason is not taking part in the circulation going on around it may be derived from the study of anticyclones themselves. They are not of single meteorological character. Local changes of many kinds may take place within them, and almost any kind of weather, except those which represent violent atmospheric changes, may be associated with their central regions."

A chapter on "Forecasts for Aëronauts" gives occasion for a concise account of the present state of our knowledge of the upper air. Brief reference is made to statistical methods for long period and seasonal forecasting, in which various periodical relationships are touched upon, though lightly, and the book concludes with a discussion of the practical utility of weather forecasts, written in an impartial and eminently scientific spirit. In this respect a strong point is made of the necessity of trained intelligence and some knowledge of meteorology on the part of the public in order to fit them to understand and test the forecasts as issued in the Press. Until some such educational groundwork is laid, Dr. Shaw thinks that we cannot be said to have a *system* of forecasting, for the work of the office is only half the story. As to the possibility of future improvements, he says:—

"It is quite possible that the progress of research, guided primarily by the wish to improve the daily forecast, will lead to the recognition of, or find material for, the development of laws of a more general character that will enable us to anticipate the weather for the season or the month. It is only by close practical study that such an object can be achieved."

The example set by the director will, we are sure, be followed by the band of trained disciples he has gathered round him at the Meteorological Office, and

even although the infallible forecaster may never arise, the advance of knowledge by the method of research cannot fail to repay many times over the wisely administered expenditure of the public money entrusted to the Meteorological Committee.

HUGH ROBERT MILL.

THE HISTORY OF MEDICINE.

History of Medicine. By Prof. M. Neuburger. Vol. i. Translated by E. Playfair. Pp. x+404. (London: H. Frowde and Hodder and Stoughton, 1910.) Price 25*s.* net.

THE first volume of this history of medicine by the professor of the subject in the University of Vienna deals with the period *ab initio mundi* to the end of the Middle Ages. A somewhat confused preface by Sir William Osler introduces the work, asserting on the first page that professorships on the subject have been established in English universities, and on the second page that "there is not in this country a single chair of the history of medicine." The Fitzpatrick lectureship on the history of medicine in the Royal College of Physicians of London is mentioned, but Sir William Osler fails to perceive that it was established with the obvious intention that the lecturer should always be a physician learned in medicine, as well as in the part of its history which he might select for his lectures. The courses which have been delivered during the past nine years by three members of the University of Oxford and two of the University of Cambridge have shown the usefulness of such a provision. They have been worthy examples of the same school as "The History of Physick from the time of Galen to the beginning of the Sixteenth Century," written by Dr. John Freind in 1723, a book which is at once pleasant reading, sound medicine, and good history.

The history of medicine as written by men ignorant of its practice and inexperienced in the observation of disease is rarely of the first order. Littré, whose writings are a valuable contribution to medical history, is no example to the contrary, for he had completed his medical education and had meditated deeply on all he had seen in the wards, though, in consequence of his poverty, he did not actually take a medical degree. It is the fact that the late Dr. J. F. Payne was a physician of wide attainments in his profession, as well as a scholar deeply read in medical books, which makes his writings such valuable contributions to the history of medicine. Van Swieten was the chief physician of Vienna, and his commentaries on the aphorisms of Boerhaave contain a better history of the growth of the knowledge of disease up to about 1760 than can easily be found anywhere else. If a medical faculty has not in it a physician willing to add to the history of medicine, his place can never be supplied by what this preface calls "archivists" and "backstairs men."

Prof. Neuburger's first volume begins with primitive medicine as illustrated by the trephine holes in Neolithic skulls and by the proceedings of modern savages. He then gives some account of medicine among the Sumerians, Babylonians, and Assyrians, sufficient to show that scarcely anything is known of it. The next chapter, on the medicine of the ancient Egyptians, contains some interesting fragments of information, but would have been more valuable had its statements been illustrated by descriptions of the actual specimens to be seen at Cairo and in other Egyptian collections. The writings of Eliot Smith are far more illuminating on the subject of the Egyptian knowledge of anatomy, pathology, and surgery. A chapter on the ancient Persians contains scarcely enough information to rouse curiosity.

The well-known passage in Ecclesiasticus on the physician is quoted, and cannot be quoted too often, but the medicine of the Old Testament is very imperfectly discussed. Robertson Smith's acute remarks on the golden emerods and mice in relation to an early epidemic of plague, for example, are not mentioned. The medicine of Hindustan and that of the Chinese and Japanese are treated in two longer chapters, and the reader anxious for first-hand information then passes on with relief to medicine in classic antiquity, to the Homeric healing art, to the Greek physicians, theories, and medical schools, and to two interesting chapters on Hippocrates. Prof. Neuburger venerates the Father of Medicine, and says that he is

"Admired by all, really understood by few, imitated by many, equalled by none; he was the master of medicine for all time."

When it is remembered that the Hippocratic school practised, as indeed is well described in this book, palpation and auscultation, it is scarcely correct to say that "Prognosis gives to the mental attitude of the Hippocratist its characteristic colouring, and leaves diagnosis far behind it in importance," though, of course, it is true that the Hippocratic view of prognosis required the practice of an almost hourly meditation on the course of the disease *pari passu* with observation of the symptoms. The transplantation of Greek medicine to Rome, Asclepiades the friend of Cicero, as well as several later physicians and schools, are discussed. Galen is dealt with in a long chapter, and the general character of his writings is justly presented to the reader. It is certainly true that by him "special pathology is well represented, and in the chaff of irresponsible speculation there is hidden many a grain of genuine observation and surprisingly clear insight." Medicine in the decline of antiquity is then described, with a somewhat disappointing chapter on Byzantine medicine and one on Arabic medicine, which adds little if anything to the account of the Arabian physicians published by Ferdinand Wüstenfeld in 1840. The second volume is to deal with the medicine of the Renaissance and of modern times.

The defect of the book is a desire to mention too many facts, with the result that few parts of the history are set forth at sufficient length to be clear or to be interesting. Prof. Neuburger's style is often rhetorical, but he generally fails to excite in his reader a living interest in the men of whom he tells or in the books which he describes, and there is the more

serious defect that references and authorities are imperfectly given, so that the work reads like a book meant to be used in cramming men for examinations and not like a real introduction to the subject. Dr. Ernest Playfair has performed the difficult task of translation admirably.

HIGHER DYNAMICS FOR ENGINEERS.

A Treatise on Dynamics, with Examples and Exercises. By Prof. A. Gray, F.R.S., and Dr. J. G. Gray. Pp. xvi+626. (London: Macmillan and Co., Ltd., 1911.) Price 10s. net.

THE preface to this book states that it is intended "to provide a discussion of higher dynamics suitable to students of engineering, physics, or astronomy." It is doubtful whether it would be a good book for intending students of astronomy, but it will be useful both to physicists and to students of applied mathematics as supplementing other treatises, and is an excellent book for an engineer whose mathematical equipment is sufficient to follow the reasoning.

Examples of problems which occur in engineering or are of special interest to engineers appear early, and continue right through the book; in addition to those included in the majority of treatises (including trajectories in resisting media) may be mentioned resistances of water to ships, steering of ships, brakes of trains, motion of wheeled vehicles, and dynamics of self-propelled vehicles. The conditions which contributed to the Salisbury accident of 1906 are fully dicussed, and although there is a misprint in the figure used in this discussion, and a misprint of $\tan^{-1}$ for $\sin^{-1}$, the results, both algebraic and arithmetic, are correct. The reasons why a blacksmith uses small and large hammers for different purposes (p. 399) do not appear in most treatises on dynamics!

Although elementary dynamical questions like the above are clearly and fully discussed, elliptic integrals are introduced where thought to be practically useful (as in the pendulum), and there is a clear and full discussion of three-dimensional rigid dynamical problems, mainly of a practical nature. The change in the ordinary figure (art. 9) by which the usual right-handed screw notation is made consistent with the traditional forms of Euler's and kindred three-dimensional equations will commend itself equally to teachers and students of dynamics, though the figure might with advantage have been repeated in the later chapters. The principle of this article is claimed in the preface to be comparatively new, but seems not to differ from that practically used by the standard treatise of Routh. The principle is, however, expressed clearly and made good use of in the chapter on gyrostats, which should be specially useful to engineering students as giving a clear and practical explanation of a subject generally regarded as difficult. The discussions of gyrostatic control of the rolling of ships, the monorail, the gyrostatic action of turbine-driven steamers, and other questions are very full, while examples, such as those on self-steering torpedoes and on the effect of the rotation of the earth on the aiming of artillery, give practical illustrations of the value of the higher parts of the subject. The gyrostats in Thomson and Tait § 345, x., are reproduced, and partially discussed; but the discussion is not quite full enough, and it may be remarked that the azimuthal equilibrium in case 3 is said to be made stable by rotation, which is contrary to Thomson and Tait's result, and seems to be incorrect.

Lagrange's equations, though foreshadowed early in the treatise (p. 112), are not introduced seriously until chapter x.; they might have been of assistance to students in the two preceding chapters, in which tops, gyrostats, motion about a point under no forces, and motion of hoops are discussed, but the authors certainly do very well without the aid of these equations. Chapter x., which gives the transformations of Hamilton and Appell of the general equations, will be more useful to students of physics than to engineers or engineering students; but in all the rest of the book except in chapter v., which deals with orbits, the needs of engineering take a prominent place. Chapter v., which is presumably written for the astronomer, scarcely differs sufficiently from the traditional treatment to be of much use to him, although some little-known theorems by G. W. Hill and others are included in it.

A rather easy chapter on some quite simple statical properties comes as a surprise at the end of the book, following the advanced chapters on rigid dynamics, and is scarcely in keeping with the character of what precedes. But the general arrangement and presentation of the subject is likely to be most useful to all engineering students of sufficient mathematical capacity, and to many students of physics and of applied mathematics.

There are a few misprints, in addition to those noted above, but none which could not be readily corrected. A little revision of pp. 392 and 393, and a re-wording of the second line of p. 137 might be useful in subsequent editions. The results of the examples, so far as the reviewer has verified them, seem to be correct.

APPLIED MICROBIOLOGY.

Einführung in die Mykologie der Genussmittel und in die Gärungsphysiologie. By Prof. Alex. Kossowicz. Pp. viii+211+2 plates. (Berlin: Gebrüder Borntraeger, 1911.) Price 6 marks.

THIS work, a companion volume to the author's "Mycology of Foodstuffs," deals with those adjuncts of the table the use of which, although not strictly necessary, and classed, and for the most part taxed, as luxurious, has become so firmly established that few of us are sufficiently Spartan entirely to avoid it. Fermented beverages, both alcoholic and (reputedly) non-alcoholic, vinegar, mustard (of the French variety), vanilla, cocoa, coffee, tea, and the post-prandial cigar are all submitted to processes of fermentation at one stage or other of their progress towards that culmination of perfection which delights the connoisseur. It is with the organisms concerned,

the changes produced, and the diseases to be guarded against in the subtle preparation of these different articles of daily use that the author is concerned.

The treatment of this varied assortment of subjects is somewhat condensed, no doubt from limitations of space, but the reader is supplied with a considerable amount of information about each, much of which is extremely interesting. In every case a useful outline of the method of manufacture or preparation is given, at all events as regards that stage of it in which fermentation is involved.

The treatment of the various processes dependent on alcoholic fermentation is too condensed to be entirely satisfactory, although all the essential points are touched upon. A somewhat disproportionate amount of space is devoted to the discussion of the "bios" question, which, however interesting in itself, is not of supreme technical importance. The fact, first observed by Wildiers, that yeast when inoculated in small amount into a synthetic medium fails to grow, was explained by him as due to the absence from such a medium of some specific material essential for yeast growth, and to this unknown substance he gave the name of bios. It is probable that the explanation advanced by Pringsheim, that yeast can only gradually adapt itself to the assimilation of the nitrogen of such media, is correct, although it seems also to be true that different yeasts possess very varying degrees of adaptability. In view of these facts it is remarkable that Pasteur was so successful in his classical experiments on the growth of yeast in simple media, and it has been suggested that this success was due to the presence of mycoderma in his yeast, the presence of this organism having been found to enable yeast to grow freely in media such as he employed.

The function of fermentation processes in the preparation of alcoholic beverages and vinegar is, of course, the fundamental one of producing the essential constituent—the alcohol or acetic acid—by biochemical change from the materials present in the liquid employed. When we turn to the other substances on our list, however, this is found to be by no means the case. Coffee consists of seeds or beans which occur firmly embedded in an integument, the whole forming the fruit of the plant. The chief function of the fermentation in this case seems to be the loosening of this integument, so that the beans can readily be separated and dried, and this is effected by the decomposition of a viscid layer immediately surrounding the seeds, an alcoholic fermentation of this material occurring first, and being followed by a stage in which acetic acid is produced, a considerable rise of temperature accompanying the change.

Black tea and tobacco, on the other hand, are submitted to processes of fermentation the object of which is the attainment of the flavour and aroma upon which their value depends. In both cases opinions are divided as to the exact nature of the process. On one hand it is maintained that micro-organisms are essential agents and it has even been proposed to impart the aroma of the finer qualities of tobacco to inferior material by inoculation with the appropriate organisms. On the other hand it is contended that the change is enzymic, due to the decomposition of glucosides and to oxidation processes, although it is admitted that organisms are present and may have some secondary and minor effect on the result. In the case of cocoa, too, some doubt exists as to the relative share of plant enzymes and extraneous organisms in the fermentation to which the beans are submitted, and which results in a dry bean of good flavour and colour.

The preparation of mustard has been specially investigated by the author. A mixture of ground white and black mustard seeds (respectively containing sinalbin and sinigrin) is treated with 2·5 per cent. acetic acid, along with salt and a mixture of spices. The chief change which occurs is the decomposition of the glucosides with the liberation of the mustard oils. The mass is then left for a few days, ground and bottled. Since the glucosides of mustard are remarkably resistant to the attack of most bacteria and the mustard oils are strong inhibitants of bacterial growth, although not particularly powerful antiseptics, it might be thought that mustard would be free from liability to bacterial "disease." This is, however, not the case, and the author has isolated two species of sporing bacteria (*B. sinapivorax* and *B. sinapivagus*) which are capable of decomposing the mustard glucosides, in one case with evolution of gas, and occasionally cause serious loss to the manufacturer. The book, which, as will be seen, deals with an extremely interesting subject, is provided with a good index and bibliography, and is adequately illustrated.

A. HARDEN.

SOME RECENT WORKS ON MATHEMATICS.

(1) *Lehrbuch der Mathematik für Studierende der Naturwissenschaften und der Technik: Einführung in die Differential- und Integralrechnung und in die analytische Geometrie.* By Prof. G. Scheffers. Zweite Auflage. Pp. viii+732. (Leipzig: Veit and Co., 1911.) Price 18 marks.

(2) *Die Integralgleichungen und ihre Anwendungen in der mathematischen Physik.* By Adolf Kneser. Pp. viii+243. (Braunschweig: Fr. Vieweg und Sohn, 1911.) Price 6 marks.

(3) *Untersuchungen über Oszillationstheoreme.* By Dr. phil. Otto Haupt. Pp. 50. (Leipzig and Berlin: B. G. Teubner, 1911.) Price 2 marks.

(4) *Die partiellen Differentialgleichungen der mathematischen Physik, nach Riemann's Vorlesungen in fünfter Auflage bearbeitet.* By Prof. Heinrich Weber. Erster Band. Pp. xviii+528. Zweiter Band. Pp. xiv+575. (Braunschweig: F. Vieweg und Sohn, 1910, 1912.) Price 12 and 15 marks.

(5) *The Dynamical Theory of Sound.* By Prof. Horace Lamb, F.R.S. Pp. viii+303. (London: Edward Arnold, 1910.) Price 12*s*. 6*d*. net.

(6) *A Logical Notation for Mathematics.* By Robert T. A. Innes. Pp. 3. (Cape Town: S.A. Association for the Advancement of Science, 1911.)

(7) *Vorlesungen über Variationsrechnung.* By Prof. Oskar Bolza. In drei Lieferungen. Pp. iv+iv+x+706+10. (Leipzig and Berlin: B. G. Teubner 1908–9.) Price 19 marks.

(8) *Die Prinzipien der Mechanik für eine oder mehrere von den räumlichen Koordinaten und der Zeit abhängige Variabeln, II.* By Leo Konigsberger. Pp. 24. (Heidelberg: Carl Winter, 1911.)
(9) *Theoretische Mechanik.* By Prof. R. Marcolongo. Autorisierte deutsche Bearbeitung. By Prof. H. E. Timerding. Erster Band, Kinematik und Statik. Pp. viii+346. (Leipzig and Berlin: B. G. Teubner, 1911.) Price 10 marks.
(10) *Sur la notion de Courbure, et sur quelques points de Geométrie infinitésimale non euclidienne.* By C. Cailler (Mémoires de la Société physique et d'Histoire naturelle de Genève xxxvii, 2.) Pp. 62. (Genève: Georg et Cie., 1911.) Price 5 francs.
(11) *Proceedings of the London Mathematical Society.* Second series. Vol. ix. Pp. xvi+489. (London: Francis Hodgson, 1911.)
(12) *Bulletin of the Calcutta Mathematical Society.* Vol. i., No. 3 (October, 1909). Pp. 70. (Calcutta: Mathematical Society, Senate House, Calcutta, 1911.) ·Price 10 rupees per year.
(13) *Revista de la Sociedad matemática española,* 1–5 (Mayo–Diciembre, 1911). Pp. 40–76. (Madrid: Dr. José Nungot, Universidad Central, 1911.)

ONE of the most important facts which modern mathematicians now realise is that the principles of the differential and integral calculus can be taught to beginners by simple methods involving only a knowledge of the rudiments of algebra, and later on of trigonometry. There are not many teachers still in the dark on these points, though a remarkable exception occurred recently when an anonymous author wrote a book intended to show that certain fools called mathematicians had made the calculus unnecessarily hard, and proved his point, not in the way he probably contemplated, but by establishing the fundamental formulæ with a wasteful luxuriance of infinite series and disregard of small quantities which would have formed a more fitting subject for a book entitled "Calculus Made Difficult." The change has been marked in England by the appearance of a flood of school calculuses, reminding one of the former flood of school geometries.

(1) In these circumstances English teachers will derive considerable interest from studying the elementary but rigorous treatment of the subject in Dr. Scheffer's "Lehrbuch der Mathematik." The first chapter introduces the arc or radian measure of angles, and deals with functions in general. It opens with a careful comparison of the uses of graphic and analytical methods of solution, which should be a lesson to those teachers who try to hide up the shortcomings of constructive geometry by making their pupils use hard pencils. The notion of a differential coefficient is introduced in the first instance by consideration of linear and quadratic functions. Then follow the formulæ for algebraic functions deduced from the sum and product rules, and the rule for functions of functions, which is here enunciated as the chain rule. Differentiation of a power is deduced from the product rule by mathematical induction, as it should be, the use of the binomial theorem being avoided. The elements of the integral calculus are treated next, and it is only after this that the notion of a natural logarithm is shown to follow directly from the calculus, exponential functions being taken in the succeeding chapter, and trigonometric functions coming next. The chapter dealing with these contains a synopsis of trigonometry. For English readers the hyperbolic notation ("ſin, cos," printed in German type) is perhaps inconvenient. Then follow successive differentiation, maxima and minima, curvature and evolutes, particle dynamics, Lagrange's and Taylor's formulæ, miscellaneous methods of integration, Fourier's series, and partial differentiation. At the end is a useful collection of tables and integration formulæ. A large number of applications are given in the form of examples, some completely worked out, others left to the reader.

It need scarcely be pointed out that no two writers would agree as to what should be included in a book of this kind, and what should be omitted. On the whole, this book tends on the side of thoroughness, rigorous development, and careful discussion of points of detail, notably in dealing with such matters as continuity. Possibly there may be few students of physics in this country who do not have to skip over and take for granted some of the arguments. But in such matters as order of treatment and rendering the subject independent of an extensive previous knowledge of algebra and geometry, the book pretty nearly reaches the goal towards which modern teachers have been striving.

The influence of pure mathematics on the progress of mathematical physics is well shown by the next group of books under review. The partial differential equations of physical problems have received so much attention at the hands of both mathematicians and physicists that we had begun to think that their study had reached a stage of finality in which nothing further of importance remained to be done. But during the last ten years harmonic analysis has been completely revolutionised by the development of the theory of integral equations, which places a new and powerful weapon in the hands of the applied mathematician. This modern theory traces its origin back to Fredholm's paper of 1900 on Dirichlet's problem, and the most important subsequent works are those due to Stekloff, Hilbert, and Schmidt; in particular Hilbert's "Foundations of a General Theory of Linear Integral Equations."

(2) Dr. Kneser's contribution to the new subject is exactly described by the following notice of the publishers:—

"The present work develops the theory of integral equations not from the starting point of analytical generalities but from the theory of heat-conduction, of free and forced oscillations and of the potential. The author thus hopes to meet the requirements of those mathematicians and physicists who wish to apply the new analytical method to concrete questions."

Now, in endeavouring to get the whole hang of the problem, so to speak, condensed in a nutshell, or, in other words, to find out what the investigations are driving at, and to put the matter in a form in which it could be explained to a pupil in ten minutes, the

present reviewer encountered a slight difficulty at the outset.

Dr. Kneser starts with the problem of linear conduction of heat, but the reduction to an integral equation depends essentially on the introduction of Green's function. Now we have always regarded Green's function as connected with the problem of the potential; and, further, most elementary English books on analytical statics get no further than explaining Green's *theorem*, and possibly stating Green's *problem*, but not defining Green's *function*. The necessary light was thrown on the subject by referring to p. 241 of Weber's treatise reviewed below, which not only gives, for the problem of the potential, the definition of Green's function, but shows, further, how this leads at once to an *integral equation* for the potential of a given distribution subject to given boundary conditions. In the case of the potential due to *fixed* charges, this integral equation, of course, degenerates into an ordinary integration formula.

In heat conduction and allied problems Green's function between two points, P and Q, might be defined as the temperature or potential function at one point due to a unit source, at the other subject to the given boundary conditions. This function is the nucleus or kernel (Kern) of the integral equation, *i.e.* the factor which multiplies the unknown variable under the sign of integration.

After heat conduction in one dimension, Dr. Kneser applies the method to the problem of small oscillations, Sturm-Liouville's functions, and problems in two or three dimensions, the remaining sections being devoted to the existence theorem, Dirichlet's problem, and Fredholm's series.

(3) A closely allied line of investigation is developed in Dr. Haupt's pamphlet on "Oscillation-theorems," which is divided into two parts, the first dealing with the general linear homogeneous differential equation of the second order containing an arbitrary parameter in its undifferentiated coefficient, while the second deals with the special differential equation of the fourth order, in which the second differential coefficient of a multiple of the second differential coefficient of the dependent variable is proportional to a multiple of the variable itself, the multipliers being functions of the independent variable. It is largely a development of Hilbert's work on integral equations, and deals in particular largely with the conditions under which such differential equations may lead to a "Green's system," and the corresponding forms of the boundary conditions.

(4) That integral equations are destined to play an important part in the formal treatment of mathematical physics is now evident. It does not appear, however, probable that they will at present supersede the use of harmonic analysis for purposes of calculation. In bringing out a fifth edition of his "Partial Differential Equations based on Riemann's Lectures," Prof. Weber plainly states at the outset that he has not been able to rewrite the book on the lines of recent researches, partly owing to want of time and energy, and also partly on the ground that the subject is now in a transient stage, in which further developments may be expected every day, so that if an attempt were made to start afresh, the whole book would soon be out of date. In addition to the theory of integral equations, a second line of recent development has grown up in the study of the principle of relativity.

In these circumstances Prof. Weber has adopted the most desirable course, namely, to introduce references to this recent work into the text at suitable places, and his book still constitutes as good an introduction to the study of mathematical physics as could well be written. Although the book has more and more become the work of Weber himself, he still desires to pepetuate the name of Riemann as having sown the seed from which this large tree has grown up.

The second volume has only just appeared. It deals with the theory of certain differential equations, heat-conduction, elasticity, theory of vibrations of strings, and membranes, electric oscillations, and hydrodynamics.

We have referred to the unsuitability, for English readers, of the German hyperbolic notation, but a greater difficulty is introduced into these German treatises by the use of a single integral sign to denote surface and volume integrals. It certainly adds considerably to clearness of exposition to use double and triple integral signs in these cases. Of course, this method is illogical as practised in this country, where a triple sign of integration is often followed by a single differential. The correct plan in such cases is to denote surface and volume differentials by d^2S and d^3V instead of dS and dV, and it is much to be wished that this were always done.

(5) The somewhat brief discussion of vibrations in the last-named treatise is a reminder that, unfortunately, a review of Prof. Horace Lamb's "Dynamical Theory of Sound" has been unavoidably delayed for an inordinate time. The subject is one which lends itself to treatment in three ways; by the publication of memoirs on specialised researches, by the production of a treatise even larger and more exhaustive than Lord Rayleigh's three volumes, and by the compilation of an introductory treatise in which the most important fundamental principles are dealt with concisely, over-elaboration being avoided. Prof. Lamb has chosen the last alternative, and has thus produced a book which should be of great use to students of applied mathematics, physics, and acoustics.

This aim at brevity necessitates the omission of details of long analytical investigations, the results of which are stated without proof; for example, under Fourier's series no attempt is made to reproduce the existing literature relating to its convergency, and the theory of vibrating systems in general is discussed briefly without reference to more than a statement of results in connection with transformation to normal coordinates. The various chapters following the introduction deal with general theories of vibration, strings, Fourier's theorem, bars, membranes and plates, plane and spherical sound waves, generation and diffraction of waves, pipes and resonators, and physiological acoustics, the last-named chapter being a summary of a branch of acoustics falling outside

the general scope of the book. It is probable that the average student would do better to follow a course of this kind, and then single out some subject for specialised study rather than to spend time on reproducing analytical investigations about the truth of which no doubt exists.

We notice that both Weber and Lamb assume that in a membrane the stress is the same in all directions —in other words, isotropic. Is this necessary? Analytically speaking, if the stress is homogeneous but not isotropic the membrane can be projected orthogonally into one in isotropic stress; on the other hand, it is fairly certain that in an actual membrane, such as that of a concert drum, it is very difficult to adjust the tension round the boundary so as to make the stresses either homogeneous or isotropic. A material membrane probably differs in its physical properties from the ideal membrane (Lamb, p. 189) to the same extent that the substance of which it is composed differs from a fluid. If this view is not correct further discussion is needed.

(6) Reference to notation under (4) leads us to Mr. Robert Innes's short Cape Town note, in which he recommends the use of small letters, Roman, italic, Clarendon, and Greek for symbols of quantity, and capital letters for symbols of operations, such as S for sine, D for differential coefficient. He does not tell us what he would do with separate differentials. In view of the fact that after these many years we still have to write cosec x for what is logically $\sin^{-1}x$, and that a Frenchman or German cannot *say* such a number as 394 in the form in which it is written, it is not much use suggesting reforms, except in notation the use of which is very limited.

(7) In a review like the present, it would be impossible to enter into a detailed criticism of the German edition of Dr. Oskar Bolza's "Lectures on the Calculus of Variations." While based on his American work bearing the same title, these three volumes aim at a more comprehensive treatment of the subject; at the same time, the author does not claim to have exhausted the theory even in the seven hundred pages which he has devoted to it. What he has rather aimed at has been to give a fairly elementary outline of the main principles of the calculus of variations, together with a more detailed treatment of its modern developments. The author's claim to have clearly expounded the fundamental definitions and methods, with the assistance of suitable geometrical and other illustrations, is fully justified by a survey of the contents. At present there are only a few people in England who study calculus of variations, and it is to be hoped that the subject will become more popular in the future in view of its important applications to physical problems. "Differentiation of an integral," which leads directly to "variation of an integral," is really one of the easiest things in the calculus to treat in an elementary way, and there can be no excuse for keeping this study, so to speak, under lock and key, only to be shown to students on rare occasions. The student of physics who goes no further than the first chapter of this book will be able to obtain a proof of Lagrange's equations of motion, together with a knowledge of the principle of least action, which will do him far more good than letting x equal a function of t, θ, and ϕ, and writing out by heart a proof of these equations involving some juggling with differential coefficients the physical interpretation of which is not obvious.

On the other hand, the need for an exposition of modern developments of the subject is shown by the many recent papers that have appeared. For example, a paper in German on the invariant form of the second variation of a double integral is contributed to the Proceedings of the Tokyo Mathematical and Physical Society for September, 1911, by M. Fujiwara.

(8) Closely allied, as leading to a generalised form of the principle of least action, are Prof. Konigsberger's papers on the principles of mechanics for one or more dependent variables, of which the second part has reached us.

(9) An examination of the contents of "Theoretische Mechanik" leads to the impression that Dr. Timerding showed want of judgment in undertaking the translation into German of a book like that of Marcolongo's. It is known that Profs. Marcolongo and Burali Forti have been engaged in drawing up a report on vector notations, as to the value of which considerable differences of opinion exist. We should not, however, take any exception to the book on this ground; but when we find in the second chapter difficult theorems in potential analysis, such as Stokes's and Green's theorems, and Poinsot's construction for the motion of a rigid body under no forces in chapter vii., while it is not until much later on that the author deals with such elementary notions as the parallelogram of forces, the principle of the lever, equilibrium on an inclined plane, and the principle of Archimedes, the book may fairly be regarded as affording a lesson as to how mechanics should *not* be taught. It forms a striking contrast to the clear and practical exposition of advanced dynamics contained in Webster's book, published by the same firm. It is becoming more and more recognised every day that the study of mechanics should be approached by beginners from the experimental side, and for this purpose elementary statics and hydrostatics form the best starting point. With such a preparation, a pupil may be able in time to grasp the nature and use of vector analysis, but to start him, as this book does, at the wrong end would be fatal.

(10) In his paper on curvature, Prof. Cailler has set before himself the task of formulating a theory of curvature of a sufficiently comprehensive character to cover the two cases of Riemann's and Lobatschewski's non-Euclidean geometries. To do this he has found it necessary to start with an algebraic definition of curvature based on considerations of kinematic geometry, and while admitting that some of the notions in his paper are of a somewhat abstract character, Prof. Cailler claims that the nature of the problem and the differences existing between the various kinds of space to which it refers render such a treatment necessary if it is to possess the required degree of generality.

(11) The volume of the London Proceedings before us continues to afford evidence of the good work that

is being done by those English mathematicians who, by denying themselves the luxuries of life, or otherwise, are able to give time and thought to original work. Applied mathematics is only represented by Dr. Nicholson's paper on scattering of light by a conducting sphere, and Mr. F. B. Pidduck's note on stability of rotating shafts. The most substantial contribution to pure mathematics is Dr. W. H. Young's series of seven papers dealing with various points regarding the foundations of the differential and integral calculus. At a time when the teaching of this subject to elementary classes is receiving so much attention, it is most fortunate that our country has been able to produce a mathematician like Dr. Young, who is underpinning this structure with a foundation of rigorous reasoning. For example, one paper is called "A Note on the Property of Being a Differential Coefficient," while in another paper on "A New Method in the Theory of Integration," the author proves a number of interesting results, such as that "an upper-upper-lower-upper (lower-lower-upper-lower) semi-continuous function is an upper-lower-upper (lower-upper-lower) semi-continuous function."

Lieut.-Colonel Allan Cunningham writes "An 8-vic, 16-ic, . . . , Residuacity," while it may be desirable to explain that Mr. G. T. Bennett's note on "The Double Six" refers to certain lines associated with quadric and cubic surfaces. We have one fault to find with the binding; the top edges of the pages are cut, but the outside edges are left rough, and are very uneven, consequently the pages soon get to look untidy; and, furthermore, the book always opens at certain pages and never can be opened at others.

One cannot, however, help regretting that there are probably many hundreds of persons in this country engaged in teaching mathematics who are ignorant of the very existence of these Proceedings. It would be a great advantage in this respect if the London Mathematical Society and the Mathematical Association could be amalgamated so that the educational and "original work" aspects of mathematics could be brought into closer touch with each other, as appears to be done in the American Mathematical Society. A very similar fusion of theoretical and practical interests has just been effected in the Aëronautical Society.

(12) One thing further is needed, namely, the publication of a summary of current mathematical literature, with abstracts of the principal papers. This is furnished by the Bulletin of the Calcutta Mathematical Society, which, in addition to original papers by Cullis and Mukhopadhyaya, contains a summary of the principal mathematical journals, reviews, lists of papers under "Societies and Academies," "Notes and News," "New Publications," and an obituary notice of Prof. Simon Newcomb.

Assuming that the Calcutta society is sufficiently powerful efficiently to continue the publication of these notes and abstracts, it is surely somewhat humiliating to think that the mathematicians of a Western civilisation should have to send to Calcutta for a list of the papers which they themselves have written. But as it is stated that the Bulletin will appear four times a year, while the number before us for October, 1909, bears the date of printing 1911, and was only received for review on October 14 last, we have some fears lest the task which these Calcutta mathematicians have undertaken may have proved too heavy for them. If so, we hope that European mathematicians will take steps to ensure the continuation of a chronicle which is unique of its kind.

(13) Although it has been mentioned in the "Notes" column of a previous issue of NATURE, the Spanish society's "Revista" may with advantage be referred to in this connection as showing that Spain has obtained an amalgamation between theory and practice of the kind which we in England have hitherto failed to attain. On the theoretical side we have papers on such questions as summation of series, polygonal numbers, generalisation of the nine-point circle, meridian arcs, and equilibrium of a moving chain (the figures, however, show the rubber belt of the barber's hair-brushing machine upside down, and the wheel moving in the opposite sense to the belt). On the more popular side we have biographies of Fermat, Nunez, Benaflah, and Siliceo, a history of Spanish mathematics, reviews, notes and news, and notes and queries columns. In addition, the society is drawing up a vocabulary of Spanish mathematical terms. We cannot better close this review than by quoting an extract from the article, "Sursum corda," by Captain Durán Loriga, on the functions of the newly founded society, in which he says, "The first which imposes itself is to create a *mathematical atmosphere* (*ambiente matemático*), in particular to convince the whole world that without that great science it would be impossible to approach the study of natural and physical sciences, which daily tend more and more to assume a mathematical form."

This quotation is not the only or even the most powerful argument in Captain Loriga's article, which further refers to the epoch-making discoveries of Abel (who lived and died in great poverty), Kowalewski, and others, and their influence on the progress of applied science. But his notion of an "ambiente matemático" should be kept prominently in mind by all mathematicians who are able and willing to take part in the campaign which in our country requires to be waged against "England's neglect of mathematics." This campaign can only be successful if everyone who is interested in the progress of pure science lends a helping hand. If they will not, then we must let the coming generation make the best it can of the knowledge which it has inherited from its forerunners, and leave posterity to fend for itself.

G. H. BRYAN.

OUR BOOK SHELF.

The Principle of Individuality and Value. The Gifford Lectures for 1911, delivered in Edinburgh University, by Dr. B. Bosanquet. Pp. xxxvii+409. (London: Macmillan and Co., Ltd., 1912.) Price 10*s*. net.

THIS may be described as a reply to the critics of Absolutism, mainly, of course, the late Prof. James. Dr. Bosanquet is always as readable as the difficulty of his subject permits, and his rejoinders are always moderate and courteous. The reader feels that the

author is really seeking the truth, and not a mere gladiatorial victory or scoring of points.

The section most interesting to scientific workers is that in which the author discusses vitalism and the relation of mind to body. Quoting Bergson, Ward, and Taylor, he expresses disapprobation of the theory of "guidance." On this theory, mind and its world, choice and action, become "utterly discontinuous." The choosing unit or element is not a system of the contents dealt with by choice. The "plan" is brought to the material; it is not in it or elicited from it. The view in question is a survival in principle of the notion of matter *plus* miracle—the attitude of common external teleology (p. 205 and foll.). Moreover, there is the difficulty about energy. The guidance theory tries to shade this down by analogies such as the trigger, the ball or water-drop on a high divide, or the spark which explodes the gas in a gas-engine. In these cases a small variation in energy-expenditure may cause huge differences in result. But some expenditure there must be. On the analogy, the mind must furnish energy without participation of the body. "Views of this type only escape manifest conflict with common sense by restricting the amount of energy so furnished to an amount below the possibility of measurement" (xxvi.).

Many readers who have studied with interest and admiration the writings of Driesch, Bergson, and Lodge on this point will feel that Dr. Bosanquet's objection is a formidable one; as is also his criticism of Prof. Bergson's startling contention that contemplative and motor memory are radically different, the former being independent of brain. It is true that these are matters of science, and philosophers must tread warily in the foreign territory; but their outlook is wider—though with less perception of detail near at hand—and their criticism is to be desired and welcomed.

A Nature Calendar. By Gilbert White. Edited and with an introduction by Wilfred Mark Webb. Pp. xii+62+xiii–xx. (London: The Selborne Society, 1911.) Price 25*s.* net.

THIS beautiful facsimile, published by the Selborne Society, reproduces a record for the year 1766 of botanical observations made chiefly at Selborne, with an occasional note on birds or insects. This record, of which the MS. is in the possession of Mr. Webb, has never been before published, and is not to be confused with the so-called "Naturalist's Calendar," often printed at the end of the "Natural History of Selborne." The printing, paper, and binding of this large volume are all admirable, and the brief introduction is adequate; it is a superb volume to lie on a drawing-room table and be admired by the chance visitor, who will, it may be hoped, at least be struck by the strong, firm, and legible handwriting of the famous naturalist. White himself would be amazed at the magnificent dress in which his humble notes were destined eventually to appear; no man could know better than he that in no sense whatever could they form even the material for a book. Yet Mr. Webb claims that "now after an interval of a hundred and twenty-three years a second *book* makes its appearance in the shape of the present volume." White published but one book, and that an incomparable one. Mr. Webb publishes for him a second one, under the auspices of the Selborne Society. Making all allowance for enthusiasm, and for the carefulness of the editing (of which the excellent index is perhaps the best part), those who know how real books can only be built up on a foundation of lengthy studies, and how unwilling an author is to have such studies exposed to the gaze of the curious, will feel some regret that this rather meagre diary should have been thus magnificently produced. W. W. F.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Contour Diagrams of Human Crania.

HAS not Prof. D'Arcy Thompson got over the "lack of fixity and precision" in the individual judgment involved in superposing two cranial contours by selecting, quite arbitrarily, the vertical axis of the transverse section as the length to be equalised in all such sections? May I suggest that he should try equalising his auricular distances, and taking his percentage differences on the *vertical* ordinates? I fancy he will then find that the differences in form of two skulls will not even be emphasised at the same places as on his arbitrary scheme.

Again, in the case of the sagittal section, there are at least half-a-dozen fundamental lines any one of which might find justification in individual judgment as a standard for equalising size. A mathematician would probably object to equalising any *lines* at all, but would magnify up all his sections to be of equal *area*. He would then be certain that the total area intercepted between his superposed contours—however placed—was zero. This would certainly mean that on any reasonable superposition the contours would be very close together. In such case for the transverse section, we should all probably superpose the median lines, but, again, whether we should put the vertex on the vertex, or the auricular line on the auricular line, or superpose neither, would be matter for discussion, if not for individual judgment. The width of individual judgment allowed in the case of the sagittal section, having regard to such standard lines as either the "horizontal plane" provides or as join nasion, bregma, lambda, inion, opisthion, and basion, is so great that Prof. D'Arcy Thompson's method would require a craniological concordat before it could be put into practical form, even supposing we could agree on what should in this case be the "area" of the section.

Still another group of investigators might consider it desirable to equalise, before superposition, not any arbitrary lines or much more definite areas, but the *volumes* of the two type crania as determined, say, by average capacities or by the product, perhaps, of three arbitrary diameters. Be this as it may, either an equalisation of areas or of volumes seems to me a more reasonable preliminary to comparison of form than any equalisation of an arbitrary line. Yet such equalisations will also leave a "lack of fixity and precision" in our results. We wish to test how far our contours are similar and similarly placed curves; we ought to bring something approaching a "centre of similitude" into superposition in both contours; the orientation in the case of the transverse and horizontal sections will present no difficulty—in the case of the sagittal it is much more questionable. The mathematician would possibly select as his centres for testing similitude the centroids of either the contours or of their areas—if he were equalising areas, probably the latter.

I would therefore suggest as a method to be compared with Prof. D'Arcy Thompson's results, say, in the first place, for the transverse contours:—(1) the equalisation of areas; (2) the superposition of centroids of areas; (3) the orientation by parallelism of median lines; (4) the comparison along rays through this centroid. Thus the contours themselves would be directly compared, and not auxiliary curves. Lastly, if the superposed contours be divided into equal *angular* elements σ, and ν be the mid-distance of any element of the first contour from the common centroid, ν' the distance along the same ray to the compared contour, then

$$m = S\left\{\left(\frac{\nu'-\nu}{\nu'+\nu}\right)^2 \sigma\right\} \Big/ S'(\sigma),$$

where S denotes a summation for every element, would be a fit measure of the degree of resemblance.

Possibly some mathematician may be willing to undertake the general theorem: Given two oval curves, the shape of which must not be changed (but size is change-

able), find a good measure of their degree of similitude with a given orientation.

The problem is one over which the late Sir Francis Galton was at times much exercised when discussing the resemblance of portraits of the silhouette type. It was further considered very fully when the proposal to prepare average or type cranial contours was originally discussed in the Biometric Laboratory some five or six years ago. Prof. D'Arcy Thompson's scheme is suggestive, but it is very far from unique. I feel doubtful whether any scheme for all these contours could possibly be other than conventional, but I suggest that, even for a good conventional scheme to be reached, we must have further knowledge of the mathematics of the subject, *i.e.* we want to study measures of the similarity or dissimilarity of what we may perhaps call "resemblant contours."

KARL PEARSON.

Biometric Laboratory, London, February 11.

The Mnemic Theory of Heredity.

IF it were explained clearly in what respects an "acquired" character is more acquired and less innate, germinal, and inherited than an "inborn" trait, a real service would be rendered to science, and, possibly, a controversy which at present seems interminable might be ended. A unicellular organism distributes itself between its daughter-cells. Here, obviously, there is actual inheritance; and, if the acquirements of the parents persist in the offspring, there is inheritance of acquirements. But a multicellular organism does not distribute itself. It is a cell-community, and, so far as is known, offspring are derived not from it as a whole, but from particular members of it—the germ-cells. There is thus no inheritance from the "parent" in the sense that there is inheritance among unicellular types. For example, the child does not inherit the parent's nose, leaving the parent derelict. The latter keeps the whole of his nose for himself.

The germ-cell is a bundle of potentialities for development. It develops into an animal or plant of the species whence it is derived under the influence of various stimuli—food, temperature, light, moisture, internal secretions, use, injury, and the like. Thus in man one kind of stimulus causes a hand to develop, another a scar, a third a use-callosity. Nothing develops in the individual, nothing can develop, unless both the potentiality and the appropriate stimulus are present. All kinds of potentialities are equally products of evolution, and are equally rooted in the germ-plasm. Thus the potentiality to develop a scar is as much a part of the germ-plasm as the potentiality to develop a head. Some characters develop more certainly than others, but this is only because the stimulus (not the potentiality) under which they grow is more certainly present. Thus a head develops more certainly than a particular scar, but the scar would develop as certainly as the head were its stimulus (a particular injury) as constantly present. In man the scar left by the destruction of the umbilical cord is as constant as the head.

It is customary to term traits which develop under the stimulus of use and injury acquired, while all others are called inborn. But if all potentialities are equally present in the germ-cell, if all characters are alike products of a reaction between internal potentiality and external stimulus, what is the peculiarity that makes one kind of character more inborn and inheritable than another? As far as I am able to judge, the Lamarckian controversy has been conducted on the basis of a misuse of terms, or on the (at present unwarrantable) assumption that the multicellular organism is derived from its parent in the same sense as a unicellular is derived, or under the belief (also unwarrantable) that the only characters that arise in response to stimulus from the environment are those which grow through the influence of use and injury. I am able to understand, for instance, how a negro who has a scar differs both innately and by acquirement from a white man who has no such scar. His potentialities are different, and therefore he differs innately; the stimuli to which he was exposed differed, and therefore he differs by acquirement. But it is one thing to apply these terms to likenesses and differences between individuals and another to apply them to characters as such. I take it that the words "inborn," "acquired," and "inheritable" have been illegitimately transferred from a connection in which they have meaning to a connection where they are unintelligible: for can anyone state precisely in what sense the skin colour of a negro is more innate or germinal than his scar?

When it is maintained that "acquirements are transmissible," it is held, in effect, that characters (*e.g.* scars and use-callosities) which the parent was able to acquire in a certain way (as reactions to injury and use), because a long course of evolution had rendered such acquisitions possible to members of his species, tend, at the time of observation, to be reproduced by the offspring in a different category of characters and in ways (as reactions to other stimuli) in which no ancestor had acquired them before, and with which, therefore, evolution had nothing to do. The evidence on which we are asked to accept this improbable supposition is usually equivocal, and, in recent times, invariably such as cannot easily be verified.

But turn to common experience. Facts are not the less valuable or certainly true because they are familiar. Take characters which develop under the stimulus of use, or, what in the case of mind is the same thing, experience. The development of some physical and mental traits, for example, the hair, the teeth, external ears, reflexes, and instincts, is not influenced by this stimulus. Other characters, for instance, in man, the limbs, heart, kidneys, brain, and all that is learnt, all that is intellectual, owe their growth after birth mainly to it. Such characters tend to atrophy when disused or little used, and to hypertrophy when much used. Low in the scale of life, animals develop less under the influence of use and more under other stimuli. But all the higher animals, in proportion as they are highly placed, impelled by an instinct, sport during youth, and thus stimulate mind and body to the acquisition of traits without which maturity is incomplete. Parental care after the beginning of conscious life is an adaptation the function of which is to afford time and opportunity for the acquisition of use-acquirements. It is not found low in the scale of life among animals that, at each stage, come ready armed by "inborn traits" to the struggle for existence, and is most elaborate and prolonged among the highest types. We call an animal intelligent in proportion as it is capable of profiting from experience. A human idiot is nothing other than an individual who, reverting to a remote ancestral type, has lost the power of growing mentally under the influence of experience.

Manifestly the so-called acquirements are more advantageous as responses to injury and use than they would be if they grew in response to the more unvarying stimuli. As they are, they render the animal adaptable, capable of fitting himself to a diversity of environment. Compare the adaptability of a man with that of a beetle. Manifestly also "inborn traits" have undergone great retrogression and use-acquirements great progression in the higher animals, which, presumably, are derived from lower types. It follows that, while a supposition that "inborn traits" tend to be transmuted into "acquirements" might be maintained with some appearance of plausibility, the contrary Lamarckian doctrine that "acquirements" tend to be transmuted into "innate traits" is untenable. The mnemic hypothesis does not demonstrate the transmission of acquirements. It merely makes confusion worse confounded by misusing another word. According to it, the germ-cell remembers that which it never knew, and forgets that which it knew.

Southsea, February 17. G. ARCHDALL REID.

THE reply to Prof. Dendy's comments upon my letter (NATURE, February 8, p. 482) is briefly as follows. The germ-cells are unicellular *living organisms* with a life-cycle of their own, part of which they pass in a metazoan individual. When they enter it, they are all in potentialities so many twins identical with this. For the time being its environment is theirs. The non-existent protoplasmic bridges need not be postulated. If the germ-cells could not "remember events in the past history of the race," I fail to perceive how any developmental unfolding would be possible. The relation of the doctrine of acquired characters to the theory depends solely upon the embryological facts of the cycle of animal life.

The enormous distinction between animals and plants regarding the problems under discussion is brought about primarily by the fact that in plants *the asexual generation* has undergone increased evolution, in animals *the sexual generation*. I might, indeed, have cited the peach tree, quoted by Prof. Dendy, instead of the chrysanthemum. Peach trees, as anyone who tends a garden knows, are reproduced *asexually by grafts*, and not *sexually* from seed, as Prof. Dendy assumes. The reason is simply that peach trees do not "come true" from seed. Probably the evergreen condition would not be repeated from seed. Coming true in grafts, this is a good example of my contentions.

A true theory of heredity, like the mnemic one, must be founded in a correct embryology, and this theory of Hering's is the sole one which can be shown to conform with the facts of the cycle of animal life. All other theories known to me are based in direct development—an impossibility. In developmental researches, which extend back so far as 1888, antithetic alternation of generations has proved itself to be the only possible mode of animal development. Moreover, this is in accord with Pasteur's fundamental researches establishing the stereochemistry of naturally occurring organic compounds. Those who with Weismann and Haeckel hold to direct development, or any theories of heredity based on this, live in a universe in which there is no science of stereochemistry, and in which the naturally occurring organic compounds have no action upon the plane of polarised light.

Nor do identical twins arise as Weismann supposed. The whole "evolution theory" of Weismann is full of such baseless hypotheses. If ordinary identical twins (AB, AB) arise so, how do the rarer ones (AB, BA), where the one is the looking-glass image of the other, externally and internally, come about? Or how are identical triplets produced, or the seven to twelve identical embryos from a single egg in the seven-banded armadillo, *Praopus hybridus*? Embryo or sexual generation does not, as is so generally believed, ever arise by the first few divisions of the egg. The facts and reasons contained in this and my former letter—though they do not profess to be all the pertinent facts—may serve to indicate why a correct appreciation of the cycle of animal life is so important for all theories of heredity, and, one might also add, for all theories of the origin and nature of cancer. For under current false theories of development cancer is "an incurable disease," whereas in the light of a true embryology and in that of stereochemistry it is *a natural phenomenon*, which Nature has demolished for untold millions of years, and which man also can cope with and destroy whenever he sees fit to imitate her and to use her methods.

J. BEARD.

8 Barnton Terrace, Edinburgh, February 15.

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(1) I QUITE agree with Dr. Reid that the mnemic hypothesis does not demonstrate the transmission of acquirements. What I said in my review was that the mnemic theory is based upon a belief in the inheritance of acquired characters—a statement that anyone may verify who will take the trouble to read Prof. Semon's book. I should perhaps have qualified the statement by saying "Prof. Semon's Mnemic Theory," though personally I cannot conceive of a mnemic theory which is not so based.

The inheritance or non-inheritance of acquired characters is, of course, still an open question, but it is interesting to reflect that such inheritance was assumed as a matter of course by the great founders of the theory of organic evolution—Buffon, Erasmus Darwin, Lamarck, and Charles Darwin—and was never called in question until the latter part of the nineteenth century. Before that time no one thought it necessary to make experiments to prove or disprove what everybody believed; since then there has not been time to make anything like enough experiments, but some of those which have been made certainly seem to indicate the possibility of the inheritance of acquired characters in the strictest sense of the term. It is not a question which can be answered dogmatically or by any amount of *a priori* argument. It was just as reasonable for Lamarck and others to suppose that such characters can be inherited as it is for Weismann and his followers to suppose that they cannot. Let us wait and see what the future may bring forth.

(2) If Dr. Beard will read the review which gave occasion for his first letter, he will find it plainly stated that the peach trees in Bordage's experiments were raised from seeds. Had they been raised in the ordinary way from grafts there would, of course, have been no point in the observations, and I certainly should not have thought it worth while to direct attention to them.

I suppose all upholders of the mnemic theory will agree that if the germ-cells could not remember events in the past history of the race, no developmental unfolding would be possible. The important point seems to be that the events in question have, for the most part at any rate, been experienced by the body and not by the germ-cells, and that unless the germ-cells received information of them from the body they could not remember them at all. This view necessarily assumes that the body is able to transmit impressions to the germ-cells, which, as I said before, is the fundamental idea of the doctrine of the inheritance of acquired characters. The experiences of the body are supposed to depend, in the first instance at any rate, upon the environment, and to give rise to "acquired" characters, and such characters, according to the mnemic theory, influence the germ-cells and are transmitted by them to the bodies of future generations.

I do not propose to discuss Dr. Beard's views on animal development, but I think it ought to be clearly stated that the mnemic theory, as ordinarily understood, is entirely independent of any such views. If Dr. Beard has a mnemic theory of his own that is another matter, but it might be well to call it by some other name.

ARTHUR DENDY.

How Pollen is Collected by the Honey-bee.

ON February 11, a mild and sunny day, my bees were working busily on *Eranthis hiemalis*, the winter aconite, and by watching them I was able to verify my opinion, published in *The British Bee Journal* of December 14, 1911, that the pollen is collected by being scraped into the fissure between the tibia and metatarsus, and is compressed and forced out into the "corbicula," or pollen-basket, on the outside of the tibia by the closing of the fissure, a conclusion suggested by the examination of the hind leg of a queen humble-bee.

One bee was watched for more than five minutes rifling flower after flower. During this time the load of pollen in each corbicula increased in size considerably, but the bee did not once cross its legs and scrape the pollen-laden metatarsal brushes on the upper edges of the opposite tibiæ, which was the way that Cheshire supposed the corbicula was loaded ("Bees and Bee-keeping," vol. i., p. 132). On the other hand, the inner sides of the metatarsi were frequently rubbed together, *the motion being longitudinal*, and it was evidently by this rubbing or scraping that the corbiculæ were loaded, for the hind legs did not come into contact with one another in any other way.

Several other bees were watched, and were found to behave in exactly the same manner. In all cases the pollen was gathered on to the metatarsal brushes direct from the anthers as the result of the bee crawling about amongst the stamens.

My observations were hampered by a gusty wind, which disconcerted the bees, and they were soon brought to a close by the sunshine passing off the flowers, so that several points that I had hoped to clear up still remain obscure.

One of these is the way in which the pollen dust is moistened with nectar. The only satisfactory manner in which, it seems to me, this can be done is for the tongue to lick the tarsi or metatarsi of the fore legs, which are covered with stiff bristles well suited for holding the nectar, the nectar being then transferred to the metatarsal brushes on the middle legs, and from these, again, to the metatarsal brushes on the hind legs. The latter being thus rendered sticky, the pollen dust would cling to them. The different pairs of legs were certainly brought together occasionally, but not after every scrape of the hind metatarsi, and their movements were so quick that it was impossible to see what was done. Still, several pollen-collecting bees that I killed had the tarsi and metatarsi of the fore legs and the metatarsal brushes of the middle and hind legs moistened with nectar, and I think it probable

that the moistening process, as outlined, is performed, as a rule, during the flight from flower to flower. Indeed, upon reflection, one feels convinced that this would be the most convenient interval in the ceaseless work of the proverbially busy bee for performing this function, while at the same time the instinct to do it then, once acquired, would ensure its accomplishment when and as often as necessary. I intend to dust with flour the hind metatarsi of bees entering flowers, and also those of bees leaving flowers. If the former retain more flour than the latter, the theory that the moistening takes place during the flight from flower to flower will be demonstrated.

Probably the kinematograph will be able before long to reproduce the whole process of pollen-collecting at a speed slow enough to be followed by the human eye.

Ripple, Dover. F. W. L. SLADEN.

Microscope Stands.

MR. J. W. OGILVY, in his reply (NATURE, February 8) to one of my questions, does little more than reiterate his former statement that the German instruments are superior, and are produced in better organised works. This seems to introduce the question of workmanship, which has not, to my knowledge, been brought under consideration. The discussion seems to be one of design.

Mr. Ogilvy also appeals for proof of superiority to the number of Continental instruments in the various technical laboratories. Even if the number in use is larger, this cannot be accepted as proof of their superiority. The number of chromatic "Abbe" condensers must be much larger than of other condensers, but this does not prove that it is the best condenser. I do not think it has been proved that the most intelligent users are to be found in the various technical laboratories. The last paragraph of "F.R.M.S.'s" letter is proof of what I mean.

Now, with regard to the sprung fittings, Mr. E. M. Nelson, writing in the current issue of *The English Mechanic*, says:—"I have always considered springing to be a most important point in microscope construction."

The question seems to be this: "Which instrument, the English or the Continental, is, by virtue of its design and workmanship combined, capable of affording the scientific worker the greatest facilities for work of a critical character?"

I venture to think that the answer to this question by our most eminent workers would not be so much in favour of the Continental type as Mr. Ogilvy seems to imagine.

Boston Spa, near Leeds. JOHN A. L. SUTCLIFFE.

As the writer of a letter on "Microscope Stands" in NATURE of February 22, I wish to add that the term "Continental firm" used in connection with the remarks on horseshoe base with extended rear toe, mechanical stage on a rotating principle, and machined slide bearings should include the American manufacturer.

F. R. BRAND.

Meteor-showers.

THE following meteor-showers become due in March; their arrangement is according to the principal maxima:—

Epoch March 1, 12h. (G.M.T.), fifth order of magnitude. Principal maximum, March 2, 13h. 5m.; secondary maximum, March 1, 9h. 30m.

Epoch March 5, 20h. 30m., eighteenth order of magnitude. Principal maximum, March 4, 12h. 35m.; secondary maxima, March 4, 9h. 30m. and 19h. 35m.

Epoch March 5, 21h., twenty-fifth order of magnitude. Principal maximum, March 6, 7h.; secondary maximum, March 5, 0h. 30m.

Epoch March 9, 22h. 30m., twenty-second order of magnitude. Principal maximum, March 8, 20h. 45m.; secondary maximum, March 8, 3h. 30m.

Epoch March 9, 3h. 30m., ninth order of magnitude. Principal maximum, March 9, 19h. 50m.; secondary maximum, March 9, 20h. 40m.

Epoch March 11, 8h. 30m., first order of magnitude. Principal maximum, March 10, 23h. 10m.; secondary maxima, March 10, 0h. 5m. and 16h. 50m.

Epoch March 12, 13h., ninth order of magnitude. Principal maximum, March 12, 12h. 50m.; secondary maximum, March 11, 13h. 40m.

Epoch March 13, 16h., twentieth order of magnitude. Principal maximum, March 13, 1h.; secondary maximum, March 12, 8h. 50m.

Epoch March 19, 22h., tenth order of magnitude. Principal maximum, March 18, 17h. 45m.; secondary maximum, March 18, 9h. 10m.

Epoch March 21, 10h., eighteenth order of magnitude. Principal maximum, March 19, 14h. 30m.; secondary maxima, March 17, 19h. 25m., and March 18, 4h. 30m.

Epoch March 19, 2h., approximately second order of magnitude. Principal maximum, March 20, 15h.; secondary maxima, March 19, 6h. 50m., and March 22, 10h. 50m.

Epoch March 22, 2h. 30m., tenth order of magnitude. Principal maximum, March 22, 3h. 20m.; secondary maxima, March 23, 16h. 25m. and 22h. 45m.

Epoch March 23, 21h., thirtieth order of magnitude. Principal maximum, March 24, 17h. 30m.; secondary maximum, March 26, 12h. 55m.

Epoch March 26, 14h., eighteenth order of magnitude. Principal maximum, March 26, 5h. 40m.; secondary maxima, March 26, 2h. 20m. and 11h. 30m.

Epoch March 27, 14h. 30m., twentieth order of magnitude. Principal maximum, March 27, 10h.; secondary maximum, March 27, 4h.

Epoch March 27, 4h. 30m., approximately first order of magnitude. Principal maximum, March 28, 22h. 45m.; secondary maxima, March 27, 12h. 10m., and March 28, 6h.

Though meteor-displays are distributed, apparently, pretty evenly over the month, yet there are periods of special intensity. These periods, which are four in number, comprise the dates March 2–4, March 9–13, March 20–22, and March 26–28. Heavy meteor-falls are due on the nights of March 2 and 4.

Dublin. JOHN R. HENRY.

EXAMINATIONS IN SECONDARY SCHOOLS.[1]

THE Consultative Committee of the Board of Education has, for the second time, made a report on examinations in secondary schools, and, though opinions may differ as to the precise value of the recommendations which the committee now makes, everyone must congratulate the members on the valuable information they have collected and the clearness with which they have shown once more the existence of a great evil, and the arguments for and against various methods of dealing with it. The report which the committee made seven years ago has been followed by a small improvement, but secondary education in this country still groans under the burden of a needlessly complicated system of examinations, which are the cause of the gravest injury, not only to secondary schools, but to all branches of higher education which depend so largely on the foundation laid in these schools.

One of the saddest points brought out in the report is the extent to which young children are at present submitted for examinations, notwithstanding the efforts of the Board of Education and certain local education authorities to prevent this. Thus a return supplied by the Lancashire Education Committee shows that nearly half of 1070 pupils of certain schools in the county submitted for external examinations during a given year were below the age of sixteen. Unfortunately, the ancient Universities of Oxford and Cambridge are amongst the greatest offenders in the matter of providing such examinations, for it appears that in their local examinations alone more than 20,000 children under sixteen were examined in 1908.

It is shown that the results of these examinations are largely used, more particularly by inferior schools, as a means of advertisement, and that this system is aided by the ancient universities by an arrangement

[1] Report of the Consultative Committee of the Board of Education on Examinations in Secondary Schools. Cd. 6004. (Wyman and Sons.) Price 2*s*. 6*d*.

by which, in their preliminary examinations, children under fourteen years of age can gain "distinctions" in individual subjects! As Mr. Paton, the high-master of the Manchester Grammar School, points out, "the endorsement of a certificate with the name of a university of national repute raises quite a false assumption of academic attainment."

Unfortunately, examinations of this kind for which a large number of candidates submit themselves are paying concerns; they are not only a source of income to the examiners employed, but the bodies which conduct them also make a considerable annual profit.

The report proves conclusively that the examinations as at present conducted are a source of at least as much (probably more) harm than good. The influence of these external examinations on the school curriculum is often distinctly bad; bookish subjects which can be easily examined get more credit than subjects of importance, such as handicraft for boys and cookery for girls, which are not readily brought into the examination net.

Not only is the curriculum damaged, but the teaching is also injured, and experiments are made difficult. If it is asked: "Why, then, do not the best teachers decline to prepare for these examinations?" the answer is that too many parents gauge the success of a school by its examination results, that many boys and girls must pass these examinations in order to qualify for the work they mean to undertake on leaving school, and that, if the schools declined to prepare for them, it would simply result in the children being forced to go to a "crammer," and so to lose such benefits as the examination system still allows the secondary schools to offer.

The subjects on the modern side of a school suffer more particularly, since existing schemes of examination tend to lessen the importance of a good knowledge of modern languages and of practical work in science. Instances are by no means uncommon when a teacher of science, in the interest of pupils who must pass a certain examination, is obliged to let them spend the time which ought to be devoted to practical work in "reading up" for the written examination. In but very few examinations is any credit given for the practical work done throughout the session. Even when a practical examination is held, it is of little use, since it can only test to a very small extent the examinee's aptitude for practical work and his understanding of the results which he obtains.

In literary subjects also the influence of the present examination system is often bad. A teacher cannot adopt what he considers the best methods, but must always have an eye to the kind of questions which the examiner, who is seldom in touch with him, is likely to set.

While the Universities of Oxford and Cambridge are probably mainly responsible for the present vicious system, it must be remembered that, as the committee points out, their objects were, and no doubt still are, undoubtedly good. They started these examinations at a time when the secondary schools of the country sadly needed guidance, both as to what should be taught and as to the standard of knowledge which their pupils ought to attain.

The modern universities are by no means blameless in the matter. With the exception of the northern universities, which have, fortunately, been compelled to adopt a common matriculation examination, each new university has taken its own view as to what its requirements for entry should be. It is true that they have adopted systems of "equivalents," but in no two cases are these "equivalents" alike, so that a boy or a girl who goes to school, say, in Birmingham, and whose parents move to London or Manchester at the age when the child is fit to enter a university, may very well find that, while the child is qualified for entry to the University at Birmingham, he cannot be admitted either at Manchester or in London without a further examination. Surely the time has come when, as in other civilised countries, there should be a school certificate which all the universities should be compelled to accept as qualifying for admission to their courses for a first degree.

But when the schools have provided for the requirements of the universities, they have only dealt with a small proportion of their pupils. The various professional bodies have various requirements for the admission of students. These are not always the same as those required by the universities; thus the Institution of Civil Engineers lays down conditions which can but rarely be fulfilled by boys who have attended schools where the training is mainly of a literary character; for the intending student must have passed his qualifying examination in more advanced mathematics and science. Why should a boy with distinct mathematical and engineering ability be shut out simply because his father has happened to send him to a classical school? By all means require him to give evidence in later examinations that he has the requisite amount of mathematical and scientific knowledge to enable him to become a competent engineer, but why block his way at entrance? The question ought not to be at this stage what the boy has learnt, but whether he has learnt it well, and whether his mind has been trained to be receptive of fresh knowledge.

Then, in addition to the requirements of the universities and professional bodies, we have the paradise of crammers provided by the Civil Service examinations. No doubt for many branches of the Civil Service special examinations are necessary, but for all except certain subordinate posts a certificate of the satisfactory completion of a secondary course should be regarded as an essential qualification. This is the case in Germany, though the Abiturienten Examen represents a longer period of training in a secondary school and a higher standard of attainment than the school certificate which the committee advocates.

If such a preliminary qualification were accepted, it would only be necessary for the Civil Service Commissioners to hold examinations in certain special subjects required by the various public departments.

The most important recommendations made by the committee are:—(1) in regard to a secondary-school certificate; (2) in regard to a secondary-school testamur; and (3) in regard to an examinations council to whom would be entrusted powers to carry into practice the principles which the committee favours.

The secondary-school certificate is to be issued to pupils not less than sixteen years of age; it is to be of approximately the same standard as the present matriculation examination, but is to be awarded not merely on written work, but partly on inspection, on an examination of the whole of the work done by the pupils, and on the marks given for such work by the teachers, who would have a consultative voice in the award of the certificate. This proposal involves a great improvement on the present chaotic system; but it represents only a step in the right direction.

It is unfortunate that in this country the majority of the pupils in secondary schools leave at about the age of sixteen or earlier, while in both Germany and America a far larger proportion remain at school until about the age of eighteen. For from this results a further drawback that, while the usual age of admission to German and American universities and technical high schools is not less than eighteen, the modern universities in this country and the technical colleges are obliged to fix their minimum age of

admission at sixteen, and so to do in the early part of their courses work which might very well be left to the secondary schools. It is, therefore, desirable that the age for the award of the secondary-school certificate should be gradually raised to eighteen, as Great Britain slowly awakes to the need of education, in order to enable us to compete on equal terms with foreigners. But at present this would be a useless counsel of perfection.

The secondary-school testamur is to be given to pupils of about the age of fifteen, and the committee suggests that great care should be taken to distinguish it "both in name and value from the secondary-school certificate." But this will be extremely difficult, and to give an alternative certificate of this kind will probably damage education in several ways. It will offer an inducement to a still larger number of pupils to leave secondary schools even earlier than they do at present. A not inconsiderable portion of the general public may very well think that a "testamur," which is a word less known to them than "certificate," is a thing of at least as great value; for to them *omne ignotum pro magnifico est.* There would be less objection to the proposed testamur if and when the certificate was given at the age of about eighteen, for there would then be a sufficiently wide gap between the standards to prevent the possibility of confusion.

The committee's suggestions in regard to the examinations council are, however, the most important. This council is to be of a representative character, including not only persons of educational experience, but also some with a knowledge of what is wanted by recruits for the professions, commerce, or industrial life. On the educational side there would be representatives of the Board of Education, the universities, the local authorities, and teachers in different kinds of schools.

The council would be entrusted with the important duty of regulating external examinations in secondary schools aided by the Board of Education, and would derive its power from the fact that no such school would be allowed to enter its pupils for external examinations other than those which the council conducted or approved. The inspectors of the Board of Education would place their experience at the disposal of the examinations council, so that the work of examination and inspection might be properly coordinated.

There can be little doubt that the formation of such a council would be of the greatest possible service, provided, of course, Parliament gave it sufficient authority to ensure that its decisions were respected. But the committee thinks that as a preliminary step the existing examining bodies might be asked by the Board of Education to confer together in order to see whether, by mutual consent, steps can be taken to bring about the state of affairs which the committee desires. It is very doubtful whether such a conference would meet with any considerable measure of success, though it is just possible that if, before convening the conference, the Board of Education made it evident that the existing examination swamp must be cleared, the examining bodies might find it expedient to agree to an amalgamation. For some of the vested interests could be considered; the majority of the existing examiners would probably be still employed, and even the officials and clerical staffs might be taken over by the new examinations council.

The committee wisely advises that, if the proposed conference be held, and it is found that those concerned will not voluntarily agree to modifications of the present system on the lines indicated, the Board should not consider itself to be relieved of responsibility, but should proceed to the formation of a representative examinations council with the powers mentioned above.

All the members of the committee signed the report with the single exception of Mr. Jackman, who objects to the proposals mainly on the ground that pupils in elementary schools will not be able to obtain the secondary-school certificate, and may, therefore, find their path to promotion barred. Some years ago this argument would have had considerable weight, for the "free place" system had not then come into being. Now, however, many pupils of the secondary schools come from the elementary schools, and it may fairly be said that in a large part of the country no bright child in an elementary school is precluded by poverty from the advantages of secondary education. If it be alleged that there are other parts of the kingdom where such exclusion takes place, then, surely, it would be better to take steps to modify this state of affairs rather than to block a most important reform affecting not merely secondary but also higher education. It is to be hoped, therefore, that the majority of teachers in elementary schools will not oppose the proposals set forth in the report of the committee, which bears the signature of Mr. Sharples, a respected member of their profession, who would not support any system likely to injure either elementary schools or their pupils.

J. WERTHEIMER.

THE PRISM-BINOCULAR.

ONE of the many revolutions which have been quietly proceeding in the last few years has been the introduction of the prism-binocular in place of the old form of opera- or field-glass. In 1851 an Italian, Ignatius Porro, devised a very ingenious and yet simple arrangement of prisms by which the simple astronomical telescope might yield an erect image. An instrument was constructed with these prisms by Boulanger, in 1859, and again in 1875 by Nachet, the firm so well known in connection with the binocular microscope. Neither of those makers succeeded in making it popular, however, probably partly because of the quality of the glass of which the prisms were made, and partly because the prisms were not well enough worked to give good images—the light is four times reflected, and it is obvious that if the reflecting faces are not all perfectly flat the definition will be seriously impaired. In 1893 Ernst Abbe designed an instrument, making use of the new glass obtained by Schott; the resulting "prism-binoculars" made under the modern conditions were an immediate success. The faces of the prisms are tested by Newton's bands of colour. These bands must be perfectly straight right up to the edge. The refracting surfaces are tested, as well as the reflecting, though perfection of the latter is the more important.

The advantages of the new form of opera-glass over the old are the great field of view and depth of focus, with a higher power. The image is not quite so bright, and therefore for night work the old form is best. In the old form, the field of view depends on the diameter of the objective as imaged by the eye-lens, and with even a moderate power the diameter has to be large; thus the glasses are clumsy. In the new form the field is independent of the diameter of the objective, and when there is plenty of light the latter can be made quite small.

The new glasses are made by several firms, and we have recently had the pleasure of inspecting some of the models made by the firm of Leitz, with magnifications ranging from four diameters upwards. The chief feature which their glasses possess over others, we have seen, is their lightness, due to the construction of the bodies of nickel-steel tubes, which

are thin and therefore light, and yet rigid and strong. One of these is a pretty little pair for ladies' use, weighing only six ounces, in a dainty case (fitted with a mirror and a small pocket), which yet has a magnification of four diameters, and an angular field of view of 11°, equivalent to a field 193 yards wide at 1000 yards. These are greater than would be obtained by an old pattern opera-glass of large size, and are very much greater than the magnification and field of the small ones usually carried by ladies, for which the former is often only two or three diameters. Even with the case the weight is but thirteen ounces.

A corresponding glass of the same power and aperture is also made for field use. In addition to the central focussing screw one of the eye-lenses has an independent focussing adjustment for correcting any difference in refraction between the eyes of the observer.

Another glass very suitable for all-round use, magnifying six diameters and weighing a pound, gives good definition over a field of 8°. To see the whole field at once, however, the eye has to be put uncomfortably close to the eye-piece; in ordinary use the field may be taken to be about six or seven degrees.

The brightness of the image depends upon the aperture of the objective (of course, also on the absorptions of the glass of the prisms and lenses, and the internal reflections). Leitz makes two models magnifying eight diameters, the one of which has an objective one inch in diameter; the other has a diameter of one and a quarter inches; with a centre focussing screw, they weigh eighteen and twenty-three ounces respectively without the case. The larger one gives a much brighter image, but this, as stated above, is unnecessary in ordinary circumstances. It is intended to be used at dusk; it is an ideal glass for a naturalist, for instance, for watching wild life in a dark wood. It is dust- and damp-proof.

High powers require a steady hand to get their full value; the eight-diameter can be used comfortably by most people, especially if the arm or elbow can be supported. But powers above this magnify the tremors of the hand so much that they are only of use for special work. Leitz makes ten-diameter and twelve-diameter models. These have large objectives and remarkably high luminosity of image; for their power their angular field is also high.

PROF. OSBORNE REYNOLDS, F.R.S.

IN Prof. Osborne Reynolds, whose death took place on February 21 at Watchet, Somersetshire, Great Britain has lost its most distinguished scientific engineer. He was born at Belfast on 1842, but spent his childhood in Suffolk, where his ancestors had, for generations, been rectors at Debach and Boulge. Having received his school education at Debenham, he entered Queen's College, Cambridge, and after a brilliant academic career, became a fellow of his college in 1867.

The chair of civil and mechanical engineering at the Owens College was founded a year later on the initiative of the leading engineers of the Manchester district, and endowed by them. A committee, on which were such men as William Fairbairn and Joseph Whitworth, selected Reynolds as the first occupant of the professorship. The foundation of the Whitworth scholarships, ten of which were reserved for Manchester students, immediately followed, and greatly assisted the early work of the School of Engineering. It is of interest to note the names of John Hopkinson and J. J. Thomson among the students who received their instruction from Osborne Reynolds. Practical instruction in engineering was unknown, when engineering was first included among the subjects taught at university colleges, and it was not until Reynolds had held his chair for nearly twenty years, that funds became available for the building of a laboratory. The Whitworth Laboratories at Manchester and Sir Alexander Kennedy's laboratory at University College were the first of their kind, and served as models for other similar institutions throughout the country.

During a period of over thirty years Reynolds was actively engaged in scientific work, including in his wide field of investigation many important problems of engineering and physics. Well in advance of his time, in many cases years elapsed before the practical bearing of his researches was fully appreciated; even now the sphere of his influence on engineering progress is still widening.

In 1874 Reynolds published his first papers on "Heat Transmission," in which he showed that in most practical cases the motion of the gas, and not its conductivity, was the controlling factor. Nearly thirty years later, the attention of engineers was directed to this work by Perry, and the principle applied to boiler construction by Nicholson and others.

Experimenting with steam, Reynolds found that in the absence of any admixture of air, the rate of condensation was practically unlimited, and he studied the effect of air on the cooling surface required, and the efficiency of the condenser. Very high vacua are not required for the ordinary reciprocating engine, and it was only in recent times, and owing to the introduction of the steam turbine, that the theory of condensers became of supreme importance, and Reynolds's work found its application.

During the six years ending 1880 numerous papers were read by Reynolds at the Institute of Naval Architects, the problems of the steering of ships and the efficiency of the propeller itself being the chief subjects under discussion. The importance of the phenomenon of cavitation, which had been studied by Reynolds in some detail twenty years before, was not generally recognised until, in 1897, the steam turbine was first applied to marine propulsion.

In 1887 a paper on the use of models for determining the *régime* of rivers and estuaries was read by Reynolds at the British Association, and led to the appointment of a committee to pursue the subject. On behalf of this committee Reynolds carried out a series of experiments which were published in three successive reports. The work attracted considerable attention, and a special commission was sent from Paris to obtain his advice with regard to the drainage works then in course of construction in the Seine estuary.

A large number of Reynolds's papers deal with problems in hydraulics. Having devised an ingenious method of delineating the stream lines by the introduction of colouring matter, he proved that there is a critical velocity at which the flow of water in a pipe becomes turbulent, and measured its magnitude. By an application of the principles thereby involved, he was enabled to design the first workable multi-stage turbine pump, of which he must be regarded as the originator; and in the further pursuance of related questions, he was led to the more theoretical and mathematical discussion of vortex motion and lubrication.

In 1889 Reynolds published a set of trials on a 100-h.p. steam engine, which he had specially designed to meet the requirements of his experimental work. These trials are repeatedly quoted in technical publications as standard examples of engine tests.

Later he conceived the idea of employing the same engine for a re-determination of the mechanical equivalent of heat. To absorb and measure the power generated, he used an ingenious form of hydraulic brake, which he had designed some years before. The value given as the result of these experiments is universally accepted.

In looking through Osborne Reynolds's collected works one is struck by the thoroughness and acumen with which he pushed his ideas to their full consequences on the theoretical and physical, as well as the practical and engineering side.

Thus while he was investigating the condensation of steam with a view to its practical explanation, Crookes's beautiful experiments on the radiometer attracted his notice, and he tried to bring the two phenomena into connection. This led him to a first attempt at explaining the radiometer action, which was subsequently abandoned in favour of the now generally accepted view. This investigation caused him to consider the relative efficiency of convection, conduction, and radiation in the transmission of heat, and he obtained results which were applied to engineering problems.

If we turn to his hydrodynamical work, we find that a practical problem—the racing of propeller screws—first led him to this subject, but he was soon drawn to questions of high theoretical interest, such as the transmission of energy in waves with their application to group velocities.

It is difficult at the present time fully to estimate the place which his great work on the "Sub-mechanics of the Universe" will ultimately occupy. His point of view differs in important respects from that which is at present in favour, but he proved right on so many occasions when he struck out a line of his own, that it would not be surprising if at any rate some portion of his work were—perhaps with a different interpretation of symbols—to find its application in the further development of our ideas on the constitution of the fundamental medium.

To those who only knew Osborne Reynolds in his later life, when a difficulty of putting his thoughts into words grew upon him, and finally developed into a fatal illness, the beautiful clearness and precision of his earlier writings may come as a surprise. Together with Roscoe, Balfour Stewart, Gamgee, Stanley Jevons, Ward, and Williamson, he formed one of the band of workers which first made Owens College famous as a centre of teaching and investigation.

He was elected a fellow of the Royal Society in 1877, and received a Royal medal of that Society in 1888, but this and an honorary degree conferred by the University of Glasgow was the only public recognition he ever received.

NOTES.

The following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Prof. J. O. Arnold, Prof. C. G. Barkla, Mr. L. Cockayne, Mr. A. L. Dixon, Sir T. L. Heath, Dr. H. O. Jones, Prof. T. R. Lyle, Dr. W. McDougall, Mr. R. Messel, Prof. B. Moore, Mr. E. Nettleship, Mr. R. Newstead, Vice-Admiral Sir H. J. Oram, Dr. G. T. Prior, and Mr. R. C. Punnett.

The King will open the London Museum, Kensington Palace, on March 21. The Queen will accompany his Majesty at the opening ceremony.

The Berlin correspondent of *The Times* announces the death, at seventy-seven years of age, of Prof. Richard Andrée, of Leipzig, known as a geographer and author of several ethnographic books.

The General Board of the National Physical Laboratory will hold its annual meeting at the laboratory on Friday, March 15, when the various departments of the laboratory will be open for inspection, and apparatus of particular interest will be on view.

In the Italian Chamber on February 24 a motion was made and carried to express the sympathy of the Italian nation with the British in the loss of Lord Lister, who was described as one of the most illustrious benefactors of humanity.

At a representative and influential private meeting on February 27, convened by the Lord Provost of Glasgow, it was unanimously agreed that a memorial of an important character to the late Lord Lister should be erected in Glasgow, the birthplace of aseptic surgery. A committee was appointed to consider various suggestions as to the form which the memorial should take, and to report upon them.

The annual autumn meeting of the Institute of Metals will be held in London on two days in the last week of September. The next meeting of the institute will be the occasion of the third May lecture, which will be delivered on May 10 by Sir J. A. Ewing, K.C.B., F.R.S., on the subject of "The Inner Structure of Simple Metals."

A Smithsonian expedition, under the direction of Mr. H. C. Raven, will start in a few days for Borneo, where a collection of vertebrates and ethnological material will be made for the United States National Museum. The field work will be carried on in eastern Dutch Borneo, the natural history of which is almost unknown.

Referring to a note on the October issue of *Tropical Life*, published in these columns on November 30, 1911 (vol. lxxxviii., p. 154), Dr. H. D. Gibbs informs us that he has written to our contemporary to correct some of the data wrongly attributed to him in the article mentioned. Dr. Gibbs points out that the writer in *Tropical Life* should have said that "750 to 1000 hectares of nipa swamp will operate a 500-ton sugar-mill 180 days each year, not a 100-ton mill continuously."

We notice with regret the death, on February 21, in his ninety-second year, of Sir John G. N. Alleyne, Bt., known as an authority in engineering and for his interest in iron and steel research, especially the application of the spectroscope to analysis. Sir John Alleyne was, we learn from *The Times*, an original member of the Iron and Steel Institute, and was a vice-president of the institute during recent years. He was also a member of the Institution of Civil Engineers and the Institution of Mechanical Engineers. He was associated with many important railway contracts, including the building of the St. Pancras Station of the Midland Railway, and was responsible for the design of much colliery plant.

Speaking in the House of Commons on Monday, February 26, the Minister for Agriculture said it is proposed to place at the disposal of Rothamsted a sum of about 2000*l.* annually to help the extension of new work on special lines of research. Arrangements are being made to send several scientific experts to India to prosecute inquiries relating to foot-and-mouth disease, in connection with the commission recently appointed upon the subject. It is anticipated that the cost of this commission will run into some thousands of pounds.

Mr. Runciman, President of the Board of Agriculture and Fisheries, has appointed a committee to advise the Board on matters relating to the development of forestry. Refer-

ences will be made to the committee from time to time as occasion arises. The committee will be asked, in the first instance:—(1) to consider and advise upon proposals for a forestry survey; (2) to draw up plans for experiments in sylviculture, and to report upon questions relating to the selection and laying out of forestal demonstration areas; (3) to advise as to the provision required for the instruction of woodmen. The committee is constituted as follows:—Sir Stafford Howard, K.C.B. (chairman), Mr. F. D. Williams-Drummond, Sir S. Eardley-Wilmot, K.C.I.E., Mr. R. C. Munro Ferguson, M.P., Lieut.-Colonel D. Prain, C.M.G., C.I.E., F.R.S., Mr. E. R. Pratt (president of the Royal English Arboricultural Society), Sir W. Schlich, K.C.I.E., F.R.S., Prof. Wm. Somerville, and the Hon. Arthur L. Stanley. Mr. R. L. Robinson, of the Board of Agriculture and Fisheries, will act as secretary.

A MEMORANDUM of the Secretary of State for War relating to the Army Estimates for 1912–13, just issued as a Parliamentary Paper, states that after careful consideration by the Committee of Imperial Defence, it has been decided to establish at once a joint Army and Navy School of Aviation at which officers of both services shall be taught to fly, before proceeding to the separate Army and Navy establishments at which they will be exercised in the more specialised requirements of their respective services. A site for the school has been selected on Salisbury Plain, and the purchase of the necessary land will be completed at the beginning of April. Building, to plans which have been already prepared, will be pressed forward rapidly, and it is hoped at a very early date to have accommodation at the school for officers and men, instructors, and mechanics, as well as the necessary sheds for aëroplanes and workshops for their repair and adjustment. Provision has also been made on an extended scale for purchase of aëroplanes and other necessary equipment for the school. The Estimates further provide for continuing the experimental and other work of the Army Aircraft Factory, for further buildings required for airships, for an addition of personnel to Army establishments for aëroplane work, and for a considerable number of aëroplanes as a first instalment of the equipment of the Field Army. The total sum provided for the above services amounts to 322,000*l*., which includes an Admiralty contribution of 14,000*l*. to the general expenses of the school. The increased provision for aviation services is 177,000*l*.

IN a lecture delivered at University College, on February 20, in connection with the Francis Galton Laboratory for National Eugenics, Dr. M. Greenwood pointed out that public opinion respecting the possibility of influencing the infant death-rate by administrative action had greatly changed during the last 100 years, the prevalent belief being that the great majority of deaths in the first year of life were due to preventable causes. Apart from the supposed ill-effects of the industrial employment of mothers, three factors had been associated in the public mind with the rate of infant mortality, viz. the birth-rate, the prevalence of artificial feeding, and poverty. The general conclusion which the lecturer emphasised was that the effects of administrative reforms upon the infant death-rate were in danger of being exaggerated. Any such exaggeration was calculated to do a great deal of harm, because expectations were raised which could not be realised, and the consequent reaction in the public mind might lead to general indifference towards the subject of sanitary administration.

THE general exhibition of lunar study which the Astronomical Society of Barcelona proposes to hold in the University of that city, under the honorary presidency of the Rector of the University, Baron de Bonet, will be open to the public from May 15 to June 15. This exhibition has for its object the grouping in one harmonious whole of the discoveries relating to our satellite. It will comprise at least the following sections:—A, lunar cartography; B, representations of the moon by drawings and models; C, photographs of the moon; D, lunar physics; E, the study of the tides; F, observatories and instruments; G, apparatus for cosmographic demonstration; H, history and biography; I, lunar astrology. The committee arranging the exhibition will be glad to receive offers of assistance from any interested persons, whether members of the society or not. Already exhibits are being received, and the society is anxious to get into touch with anyone who possesses books, drawings, photographs, sketches, models, &c., of items of lunar interest. The last day for entries is April 15, and the last day for receiving exhibits is May 1. The society offers diplomas to exhibitors and to all who contribute in any way to the success of the exhibition. All correspondence and offers of help, &c., regarding the exhibition should be addressed to Don Salvador Raurich, secretary of the society, Gran Via Diagonal, 462, Barcelona, Spain.

DR. A. H. YOUNG, Emeritus professor of anatomy in the University of Manchester, a former president of the Anatomical Society of Great Britain and Ireland, died at his residence in Didsbury on February 22, of an illness which had incapacitated him for the past three years. Prof. Young exercised a considerable influence upon British anatomy during the last quarter of a century, not only by his own investigations, but even more so by the researches which he inspired his assistants to carry on. Much of his earlier work, such as the memoirs on the anatomy of the elk, the hyæna, and the northern beluga, was done in collaboration with his predecessor, Prof. Morrison Watson; but at the same time he carried out a series of investigations of his own upon the anatomy of Phascolarctos, Viverra, Proteles, and the elephant, devoting especial attention to the musculature of the marsupial hand and forearm. After he succeeded to the chair of anatomy in Manchester he and his assistants became interested in embryology, and they produced a series of morphological memoirs, in which the facts of ontogeny and comparative anatomy were happily blended. Prof. Young himself concentrated his attention mainly upon the problems of the morphology of arteries, his best known work being his strong attack upon the commonly accepted interpretation of the middle sacral or caudal artery as the prolongation of the dorsal aorta.

IN a Reuter telegram from Khartûm which appeared in the Press last week, it was stated that Prof. Garstang had discovered at Meroë evidence that the Roman Empire extended much further south than has hitherto been supposed, even to Meroë (Kabushîa) itself, the evidence for this conclusion being the discovery of a Roman temple, &c. In this way, the telegram adds, the presence at Meroë of the Augustus-head discovered last year is explained. We have not as yet the facts of the discovery which have led Prof. Garstang to this conclusion, but until they have been carefully examined it would be rash to accept so revolutionary a statement as certain. Hitherto, though the Roman legions are known to have marched so far south as Gebel Barkal (Napata) in the reign of Augustus in order to punish a Nubian invasion of Egypt, the southernmost Roman permanent post has always been supposed to have been Primis (Ibrîm), and this was only occupied for a short time, the usual "furthest south"

having been Syene (Aswân), or at most Hierasykaminos (Mahárraka), at the southern end of the Dodekaschoinos. No literary authority under the Empire gives the slightest hint of any such thing as a Roman station far south of Napata, and within 150 miles of Khartûm, and until definite evidence comes from Prof. Garstang we must suppose that his Roman temple is no more than a Nubian copy of one, and means no regular Roman station. Had there been such a station at Meroë, Strabo could not have failed to mention it.

The "Memorandum to Sanitary Authorities on the Subject of Epidemic Poliomyelitis" (infantile paralysis, see Nature, vol. lxxxvii., p. 494), which was issued by the Local Government Board in December, 1911, has now been followed by the publication of further reports upon the subject (New Series, No. 61). The volume contains a report by Dr. Reece on the prevalence of the disease in Devonshire and Cornwall in 1911; another, by Dr. Farrar, on outbreaks in the Midlands and Dorsetshire in 1910; notes by Dr. Mervyn Gordon on the bacteriology of the disease; and clinical and epidemiological notes by Dr. Hugh Macewan. The number of known cases in the Devon and Cornwall outbreak up to September 16, 1911, was 154, with thirty-four deaths, but probably many mild and abortive cases escaped notice. The report concludes with a grave indictment of some of the public authorities of the districts concerned on account of their reluctance to take the steps necessary to cope with the disease.

We are glad to welcome a new series of publications by the Museum of the University of Pennsylvania. The series will comprise the publications of the Babylonian section of the museum; and a beginning has already been made by the issue of a monograph on "Babylonian Hymns and Prayers," by the Swedish scholar Dr. David W. Myhrman. It is well known that the University of Pennsylvania possesses a very rich collection of tablets obtained as the result of four expeditions which conducted excavations on the site of the Babylonian city of Nippur between the years 1888 and 1900. The greater number of the texts published in the present volume are from this site; others are from collections purchased in London and Baghdad. The tablets contain religious compositions, the majority of which are written in Sumerian, the language of the early non-Semitic inhabitants of Babylonia. Since they date from the end of the third millennium B.C., they are of very great interest as throwing light upon the development of Babylonian religious ideas in their earlier stages. Dr. Myhrman has expended an immense amount of labour in order to reproduce the original script as closely as possible, working on the principles which have governed earlier publications of the Pennsylvania Museum. But, at any rate in the more crowded texts, we could wish that a more conventional transcript had been adopted; this would undoubtedly save time in publication, and would be a real help to the reader. The excellent photographic plates already furnish the student with the necessary epigraphical data. But, apart from this suggestion, we have only praise for the volume before us, which makes the texts available for students on the plan already employed by the great museums of London, Paris, and Berlin. We note with pleasure that the new series largely owes its success on the material side to the generosity of Mr. Eckley Brinton Coxe, jun., who has already done so much to further the scientific aims and interests of the University of Pennsylvania.

An account of the vertical migrations of *Mysis mixta* in the Baltic is given by A. Otterström in *Meddelelser fra Kommissionen for Havundersögelser*, Plankton, Bd. i., No. 9. The observations deal only with the summer months June, July, and August. During the daytime the Mysis are found only on the bottom. Between 8 and 10 p.m. they move upwards into the higher water layers, the height to which they rise apparently varying with the intensity of the light. The author considers that the whole phenomenon is controlled by light-intensity, and that temperature has little, if anything, to do with it. As *M. mixta* is an important food of the herring in the Baltic, the question is one of some practical interest.

Two papers recently published by Danish investigators (Danish hydrographical investigations at the Faroe Islands in the spring of 1910, by Martin Knudsen, in *Meddelelser fra Kommissionen for Havundersögelser*, Hydrografi ii., No. 1, and The plankton on a submarine bank, by Ove Paulsen, in *Biologiske Arbeider Tilegnede Eug. Warming*, November, 1911), throw new light upon an oceanographical problem of very considerable interest, namely, the physical and biological conditions upon an isolated bank surrounded by deep water in mid-ocean. The Faroe Bank, which the two authors deal with, lies in the Atlantic at a considerable distance to the S.W. of the Faroe Islands. The temperature of the water on the bank is lower than that of the surrounding ocean water at similar depths, and at the same time the salinity is less. The water on the bank agrees in these features with water from lower depths in the surrounding ocean, and Dr. Knudsen is probably correct in his view that the bank is covered by water which has run up along the slope of the bank from the deep water surrounding it. The plankton on the bank itself is shown to be markedly different, at all seasons at which samples were taken, from that found in the immediate neighbourhood off the bank, the bank plankton having a distinctly neritic, or shallow water, character.

We learn from *The Journal of Agriculture of South Australia* that an anonymous donor has presented a sum of money to the University of Adelaide for the purpose of providing scholarships for post-graduate work. These are to be called the Lowrie scholarships, in recognition of the services rendered by Mr. William Lowrie, the director of agriculture for the colony. It is proposed that the scholarships be tenable for one year.

We have received a copy of *La Vie Agricole*, a new weekly agricultural paper issued by J. B. Baillière et Fils, Paris, proposing to deal with scientific and practical matters of agricultural interest. Prof. Perrier gives an interesting summary of the problem of sex determination, whilst M. Diffloth writes an informing article on the desiccation of potatoes in Germany. Summaries are also given of investigations carried out in other countries. Altogether, the new journal promises to form a very useful addition to agricultural literature.

It appears from *The Journal of Agriculture of South Australia* that the policy of repurchasing estates for closer settlement in South Australia continues to justify itself by the results. Large estates are bought by the Government and subdivided into small holdings of about 300 acres. In one case, where formerly not more than 400 persons inhabited a large area, the population rose under the new system to more than 4500. The value of the improvements effected is invariably high. A very great change in the agriculture of the country is certain to set in, with results that must be wholly beneficial.

After exhaustive experiments with practically all improved artificial pasture grasses, extending over a period of some eight years, the Department of Agriculture in Natal has, we learn from *The Agricultural Journal of the*

Union of South Africa, been compelled to the opinion that *Paspalum dilatatum* and *Phalaris commutata* are the only types which promise to hold their own for more than two years in the veldt conditions obtaining in the midlands of Natal against the competition of native grasses and the weeds of cultivated ground. Paspalum flourishes on very poor soil, and proved excellent for stock. Phalaris is more resistant to frost, but less tolerant of drought and soil poverty. Favourable reports on these grasses are also received from the Transvaal.

RECENT numbers of the Circular and Agricultural Journal of the Royal Botanic Gardens, Ceylon, deal largely with experiments on the tapping of Hevea rubber, by Messrs. Lock, Bamber, and Holmes. A remarkable pest is also described by Mr. Green. The rubber slug, *Mariaella Dussumieri*, Gray, frequents recently tapped Hevea trees and imbibes the latex oozing from the cuts, thus causing an appreciable diminution of the scrap rubber that could be collected after tapping. It seemed barely credible at the time that any animal could digest liquid rubber, but direct experiment showed that when some of the living slugs were provided with a saucer of rubber-milk they at once began to lap it up. The slugs, further, do serious injury to young plants. The only remedial measures at present suggested are traps and the destruction of all rubbish.

A PAPER has been published in the Journal of the Asiatic Society of Bengal, by Mr. B. Hooper, on phosphorus in Indian foodstuffs. The author begins by accepting the well-known conclusions of certain medical investigators that the lack of phosphorus in cleaned or milled rice is the predisposing cause of beri-beri. By experimenting on fowls with rice of varying quality, it was demonstrated that polyneuritis (similar to the human disease) was developed when milled, but not husked, rice was used. Rice containing only 0·277 per cent. of phosphoric anhydride brought on the disease in a few weeks, while rice containing 0·469 per cent. formed a healthy diet. A number of analyses have therefore been made of rice samples from various parts of India. On an average, unmilled rice contained 0·65 per cent. of phosphoric anhydride, and milled rice 0·38 per cent. The pulses contained more, and it is significant that the pulse-eaters generally remained free from the disease, whilst their neighbours, the rice-eaters, were attacked.

NOT long ago the Secretary of State for the Colonies announced that it had been decided in principle to maintain the central establishment of the Imperial Department of Agriculture for the West Indies for a further period of ten years. The opportunity has therefore been taken in No. 4 of the West Indian Bulletin to review broadly the work of the Department in the past, and to indicate some of the problems for the future. There are undoubted signs that the West Indies are recovering from the distress in which they have been plunged during the latter part of the nineteenth century. Confidence in the sugar industry has revived as the result of the abolition of bounties and improved trade relations with Canada; the production of cacao in Trinidad, Grenada, and Jamaica has increased; a considerable American fruit trade has grown up in Jamaica; Sea Island cotton has been introduced into St. Vincent, Barbadoes, and the Leeward Islands; limes have been much grown in Dominica, and rice in British Guiana. But if the conditions are favourable for crops they are equally favourable for pests, and perhaps nowhere is more careful and continuous work necessary on the part of mycologists and entomologists. There is also much scope for the work of the plant-breeder, for it has been shown that some of the new seedling canes are very much more profitable than the older ones.

THE current issue of the Journal of the Quekett Microscopical Club (November, 1911) contains interesting observations, by Mr. D. J. Scourfield, on the use of the centrifuge in pond-life work. He finds that a high speed (7000–10,000 revolutions per minute) is necessary to bring about the concentration of some of the more minute organisms; when so high a speed is required, centrifuge tubes holding only about 1·5 c.c. are used. This method is to be regarded as accessory to the ordinary methods of collection by means of nets and filters. Mr. C. D. Soar gives a list of fifty species of Hydrachnids (water-mites) collected, for the most part near London, by the late Mr. Saville-Kent, whose account of the anatomy of these animals is also published. Mr. E. M. Nelson contributes some hints on methods of illumination in microscopic work, and lays great stress on the importance of centring the beam of light entering the objective, in order to obtain good definition. Whether the beam is centred properly is most readily ascertained by examining, either with the unaided eye or with a hand-lens, the "Ramsden disc," the centre of which should be illuminated. Mr. Nelson adds some notes on the use of colour-screens. Dr. E. Penard gives an account of fourteen species (three of which are new) of fresh-water Rhizopods from Sierra Leone, and Mr. T. A. O'Donoghue records the finding of dimorphic spermatozoa in the human flea and in the blow-fly.

WHILE the geology of Newfoundland has been investigated to some extent, its physiography has hardly been touched upon from the modern point of view. In the January number of *The American Journal of Science* Mr. W. H. Twenhofel contributes a very instructive description of the island from his observations made during a study of the geological structure of the western and north-western coasts. The topography is strongly impressed by the structure, of which the north-easterly trend finds expression in parallel ridges and valleys having the same direction as the folds and faults, softer strata and zones of weakness having been eroded. The upland surface presents the dissected remains of a former peneplain, which once extended over the whole of Newfoundland, and which it is suggested may have been completed before Cretaceous time, like that of the Appalachian region. Elevated valleys occur at altitudes of 800 to 1200 feet, and may probably be attributed to erosion at a period when the land stood lower by about this amount than at present. This cycle of erosion was not completed, but was interrupted by renewed uplift of the Long Range in pre-glacial times, since the evidence tends to show that this range owes its origin to the faulting upward of a block from the foreland's level.

THE Survey Department of Egypt has commenced the publication of Bulletins dealing with the astronomical and geophysical work carried out at the Khedivial Observatory at Helwan. No. 1, by Mr. E. B. H. Wade, deals with the local attraction of the plumb-line in the prime vertical near the Nile Valley, which has been observed during the work on the geodetic survey of Egypt which is in progress. It had been anticipated that so much as 2″ might be met with, but when the triangulation had been carried about 150 kilometres south of Cairo the values obtained for a pair of azimuths taken to and fro across the valley were found to be discordant to the extent of 11·9″. After the careful elimination of instrumental errors, a direct determination of the difference of longitude between the observa-

tory on the east and a base terminal point on the west of the valley by a method especially suitable to the case, and the reobservation of the azimuth of the southern side, the conclusion is reached that in this part of the Nile Valley the local attraction in the prime vertical is 8·8″ and 6·9″ by different methods on the northern side, and 12·6″ on the more southern side, the plumb-bob being repelled from the axis of the Nile Valley. The method employed is described.

We have received the fourth and concluding part of the first volume of the Bulletin of the Seismological Society of America. The papers which it contains are mostly brief. Among the more interesting may be mentioned a biographical notice with an excellent portrait of Major C. E. Dutton, described, in forgetfulness of Prof. C. G. Rockwood, as America's first seismologist. Mr. Otto Klotz gives a simple method of locating the epicentre of an earthquake from the duration of the first series of tremors at three widely separated stations. Mr. E. C. Templeton describes a rather strong earthquake on July 1, 1911, in Central California. From the nature of the shock and the disposition of the isoseismal lines it is evident that the earthquake was a twin, the more important of the two foci being situated near Coyote, a village twelve miles south-east of San Juan. The paper of greatest value is one by Prof. A. C. Lawson on a remarkable series of small post-Glacial fault scarps near Banning, in western Ontario. They have been exposed by the removal of the glacial drift, which until recently has helped to preserve the sharpness of the scarps. The glaciated rock so far uncovered is about a quarter of an acre in area, and is dislocated by a large number of small reversed, or overthrust, faults. Along a transverse line 66 feet in length twenty-four scarps were counted, the height of which ranges from an eighth of an inch to 3¾ inches. The movement of the faults, as shown by the displacement of the glacial striæ, was invariably in the direction of the dip.

The Journal of the Franklin Institute for January contains a noteworthy paper, recently read by Prof. Cleveland Abbe, entitled "The Obstacles to the Progress of Meteorology." To form an adequate idea of the important questions dealt with it would be necessary carefully to peruse the paper. Prof. Abbe states at the outset that he is not a pessimist. He says:—"We have been so long accustomed to fairly accurate and very useful daily weather forecasts that we begin to look for perfection in long-range predictions. Let us be optimistic and believe that eventually these will come." But he asks why it is that that progress has been so slow, and why we have been unable definitely to establish the existence of periods in our local climates. Possibly they do not exist, but if they do they are completely covered up by the defects of observations. He gives a number of illustrations showing that observations have been at fault because instruments have been faulty, exposures changed by growth or disappearance of trees, and various other causes. Although balloon observations now record what is going on ten or fifteen miles above us, and although daily weather maps have been published for the whole of the northern hemisphere, the great obstacle that hinders perfect prediction is our ignorance of many details as to the laws that govern the atmosphere. The author considers that the existence of laboratories specially adapted to atmospheric experiments is of fundamental importance, and the association therewith of able students trained in mathematics and physics. "When all this is realised, the intellectual work that will there be done will gradually remove all obstacles to the eventual perfection of our knowledge of the atmosphere." But, as in the case of astronomical observatories and all other scientific institutes, plans must be made for many years of labour.

Since the introduction of the earth inductor as an instrument for the determination of the magnetic dip, the question is often asked, Does the earth inductor or the dip circle give the more accurate results? The editor of *Terrestrial Magnetism and Atmospheric Electricity* gives the results of his experience in a note in the December (1911) number. The earth inductor, once set up, gives a result in fifteen minutes five times as accurate as the dip circle will give in an hour. While dip circles differ amongst themselves by a few minutes, inductors agree to within a few tenths of a minute of arc. For survey work, when the instrument has to be set up afresh at each place of observation, the present type of inductor has no advantage over the dip circle, but it is hoped that ere long an inductor suitable for such work will be constructed.

The first number of the Science Reports of the Tôhoku Imperial University, Sendai, Japan, contains an important paper by Prof. Honda on the thermo-magnetic properties of forty-three chemical elements, most of which were obtained in a state of great purity. The magnetic susceptibilities of these elements up to temperatures in many cases exceeding 1000° C. were measured by the pull exerted on them by the non-uniform magnetic field between the pointed poles of a Du Bois electromagnet. The strength of the field could be increased to 23 kilogauss, and was determined by the aid of a small coil and a ballistic galvanometer. The pull was measured by means of a torsion balance. With the exception of iron, nickel, and cobalt, these elements have susceptibilities which are independent of the intensity of the magnetic field. Some of them change their susceptibility with change from solid to liquid or from one crystalline form to another. The susceptibility appears to be connected intimately with the position of the element in the periodic system of chemical classification. The laws stated by Curie, *i.e.* for diamagnetic substances, susceptibility generally independent of temperature, and for paramagnetic inversely proportional to the absolute temperature, were found not to be correct, and Prof. Honda substitutes the law: increase of temperature produces a change of susceptibility towards that of the element of next higher atomic weight.

Some interesting conclusions concerning the spectra produced in gases and vapours by different types of electric discharge are recorded by M. G. Millochau in a paper which is published in No. 18, vol. cliii., of the *Comptes rendus*. By projecting an image of the spark on to a slit, an image of which was in turn projected on to a photographic film revolving at a known rate, the author obtained photographic evidence as to the nature and duration of the discharge. At the same time he photographed the spectrum produced in various gases, enclosed in Plücker tubes, by the different discharges, and so was able to correlate the different spectra with the respective types of discharge producing them. By this means he differentiates seven types of "simple" discharges, each of which always produces the same spectrum, whatever may be the pressure in the tube, and finds that in a complex discharge the resulting spectrum is the summation of the spectra produced by the several superposed "simple" discharges; the simple discharges range from a continuous discharge obtained, for example, by joining up the terminals of the secondary of a Ruhmkorff coil, without condenser, directly to the terminals of the vacuum tube, to an intermittent discharge from a condenser through a considerable resistance. The "simple discharges" may be grouped under three general heads:—(1) the slow dis-

charge, (2) the "semi-brusque" discharge, and (3) the "brusque" discharge, of which the respective durations are of the order of 0·01 sec., 0·0001 sec., and 0·00001 sec., and M. Millochau briefly describes the different types of spectra produced in various gases by each. Thus in CO_2 the first produces the "Swan" spectrum, while the second produces the spectrum of carbonic oxide in place of the "Swan." With the "brusque" discharge, "line" spectra are produced, the lines of hydrogen and helium being always broad. Finally, M. Millochau arrives at the most important conclusion that his results favour the dissociation hypothesis, inasmuch as they appear to show that the production of the various spectra depend upon the temperature of the vibrating molecule and upon the dissociation effects which correspond to this temperature.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MARCH:—

March 2. 2h. 0m. Mercury in superior conjunction with the Sun.
4. 5h. 0m. Mars at quadrature to the Sun.
4. 16h. 0m. Jupiter at quadrature to the Sun.
9. 22h. 36m. Jupiter in conjunction with the Moon (Jupiter 4° 59′ N.).
13. 19h. 12m. Uranus in conjunction with the Moon (Uranus 4° 43′ N.).
15. 19h. 6m. Venus in conjunction with the Moon (Venus 3° 43′ N.).
19. 16h. 44m. Mercury in conjunction with the Moon (Mercury 1° 47′ N.).
20. 11h. 30m. Sun enters Sign of Aries; Spring Equinox.
22. 6h. 14m. Saturn in conjunction with the Moon (Saturn 1° 36′ N.).
24. 20h. 30m. Mars in conjunction with the Moon (Mars 2° 44′ S.).
26. 16h. 19m. Neptune in conjunction with the Moon (Neptune 5° 53′ S.).
27. 14h. 0m. Mercury at greatest elongation east of the Sun. (18° 51′ E.).
31. 17h. 0m. Venus in aphelion.

THE ECLIPSE OF THE SUN ON APRIL 17.—In a memoir prepared by the Madrid Observatory there is an excellent account of the conditions for the total and annular eclipse which will be visible in the peninsula on April 17 next. Intended for popular information, the memoir contains not only the data calculated for the eclipse in general and for several favourable localities, but also gives an account of the geometry of eclipses, the methods of calculation, the results, and some excellent diagrams and maps showing the track of the shadow.

As an example of the application of the method of calculating the values for any particular place, Cacabelos (long. = 6° 42′ 57″ W. of Greenwich; lat. = 42° 35′ 53″ N.) is selected, and for this place it is found that totality will last 4·6 seconds, the middle of the eclipse occurring at 23h. 48m. 54·7s. Other places where the eclipse will be total were selected, and, in order to ensure accuracy, a commission was appointed to determine their geographical coordinates. They are Barco de Valdeorras and Verin, and their positions were found to be:—long. 3° 17′ 43·5″ W. of Madrid, lat. 42° 25′ 5·4″ N., and long. 3° 45′ 12·0″ W. of Madrid, lat. 41° 56′ 29·0″ N., respectively. The track of the eclipse across the peninsula is shown on a large-scale map (1 : 500,000) at the end of the memoir, the central line passing from immediately north of Ovar, in Portugal, to Oviedo, and leaving the northern coast slightly to the east of Gijon.

THE EARLY BABYLONIAN ECLIPSE OF THE SUN.—In a paper appearing in part iii., vol. ii., of the Transactions of the Royal Society of South Africa, Mr. Nevill discusses at length the vexed question of the date to be assigned to the eclipse of the sun recorded on Tablet No. 35968 of the British Museum collection, which Dr. Cowell has identified with the eclipse of −1062, July 31. He describes the broken tablet, and discusses Mr. King's reading of the same from several aspects, arriving at the conclusion that the internal evidence does not preclude a date in the twelfth century B.C., or even earlier. After examining every eclipse occurring between 1250 and 920 B.C., Mr. Nevill, by several processes of elimination, finds that, without assuming any secular acceleration of the sun's motion, the eclipses which fit the various conditions, of time, date, place, &c., best are those of June 5, 1217, May 18, 1123, and May 31, 956 B.C., and of these three the first most closely corresponds with theory and observation.

Finally, he points out that Dr. Cowell's hypothesis of secular acceleration, permitting a number of ancient eclipses to be recognised, constitutes a strong case if no other hypothesis can be found, but its adoption raises several questions which for the present cannot be satisfactorily answered.

THE PROPER MOTIONS OF THE STARS IN THE CLUSTERS h AND χ PERSEI.—Vol. v. of the *Recherches Astronomiques de l'Observatoire d'Utrecht* is devoted to a thesis prepared by M. A. van Maanen dealing with an investigation of the proper motions of 1418 stars in and near the famous double cluster h and χ Persei.

The object of the investigation was twofold: first, to find the proper motion of the two clusters; secondly, to determine the frequency of the proper motion according to its amount and to the magnitudes of the stars for this region of the sky. From a number of plates six were selected, two pairs taken by Kostinsky in 1896 and 1908, and one pair by Donner in 1892 and 1909, and among the conclusions arrived at it is maintained that this method of using pairs of plates is not inferior to that where the images are impressed upon the same plate at different epochs. The proper motions resulting from the discussion are so small as to render it impossible to make out which stars are, and which are not, members of the groups. In determining the frequency of the proper motions, it was found that, of the 763 stars considered, 300 had P.M.'s between 0·010″ and 0·019″, while only 142 had motions less than 0·010″; no sufficient reason has yet been found for the relatively small number of small proper motions.

THE TERRESTRIAL MAGNETIC EFFECTS OF SOLAR RADIATION.—In an extract from *Ciel et Terre* (No. 12, 1911) Dr. A. Brester discusses the causes which produce the diurnal oscillation of the magnetic needle and other terrestrial magnetism effects. In the place of the vortices produced by the heating effects of the solar radiation, he would substitute vortices produced by solar kathode rays, and he shows how the action of these would be concentrated in the neighbourhood of the earth's poles where the greatest oscillations of the needle are recorded. Further, he points out that electrical tourbillons would not be disturbed by ordinary atmospheric disturbances, and thus would give regular changes such as are observed, and also that, the electrical state of the sun depending on the solar activity, his theory would account for the observed relation between the diurnal oscillations of the needle and the number of sun-spots.

ABSORPTION OF LIGHT IN SPACE.—The January number of the Monthly Notices contains an interesting paper by Mr. F. G. Brown, in which the author discusses the absorption of light in interstellar space. Taking all the nebulæ given in the N.G.C., he found approximate measures of the intrinsic brightness of each by comparing the total brightness, or conspicuousness, as given in the N.G.C. with the diameter. Although this method of dealing with the subject cannot be regarded as final, the results are very striking, and indicate that the small nebulæ appear less bright per unit area than do the large nebulæ, or, in other words, the probably distant are fainter than the probably near. Mr. Brown's preliminary investigation also suggests that the absorption is different in different directions through space.

AN OBSERVER'S HANDBOOK.—"The Observer's Handbook for 1912," published by the Royal Astronomical Society of Canada, is a valuable compendium of the data likely to be required by the isolated amateur. It contains various ephemerides and tables, useful star-charts, notes on the constellations and phenomena for each month, tables showing the times of sunrise and sunset for each day in latitudes 44°–52°, and brief accounts of the eight comets of 1911. The handbook contains sixty-four pages, and is sold for 25 cents at the society's rooms, 198 College Street, Toronto.

A SELF-CLOSING PLANKTON NET FOR HORIZONTAL TOWING.

A SELF-CLOSING plankton net has long been needed for horizontal towing. It is especially necessary for the investigation of the vertical distribution of pelagic organisms. Numerous attempts have therefore been made, from the time of Pavesi (1883) onward, to devise a satisfactory instrument for this purpose. The latest, and apparently the most satisfactory one of its kind, has been designed by Prof. Kofoid after suggestions from Dr. G. H. Fowler, of the *Research* expedition.

The net is a ring net with circular opening, which can be both opened and closed under water by messengers. The bag of the net is, as usual, of silk bolting cloth, a simple cone held horizontally by a support. The frame is a heavy casting of phosphor bronze, with enlargements at the horizontal axis for the reception of the hubs of the jaws of the net. The upper end of the frame is expanded to form a head-piece enclosing and protecting the tripping mechanism for the net jaws, and the lower edge bears a slot for attaching the heavy weights.

A Self-closing Plankton net.

The net is balanced in a vertical position by the very heavy lower flatiron-shaped weight.

The mouth of the net is formed not by one continuous ring, but by two hinged jaws, which can both be brought up and held together by the tripping apparatus. In the figure both jaws are in this position, and the net mouth is closed, the net being ready for descending. The two semicircular jaws can rest in three positions: they may be both folded against each other and held upwards as in the figure, or one may be allowed to fall forwards and downwards until both jaws complete a circle and the net mouth is open. In the third position both jaws lie against each other, but hang downwards.

There are two "trips," one of which is operated by the first messenger, the other by the second.

The net is lowered vertically, the ship being at rest, to the desired depth, and the first messenger sent down the cable. This releases the lower jaw, which falls forwards and downwards until the net mouth is open.

After towing is completed and the cable is perpendicular, the second messenger is sent down, and the upper jaw is released. It falls to the lower position, is held firmly against the lower jaw, and thus the net is closed.

The advantages which this net possesses over other models are stated by Kofoid to be:—

(1) A method of opening and closing at any level in the sea under complete control of the operator.

(2) Perfect and continuous closure of the net during descent and ascent.

(3) Possibility of horizontal towing.

(4) An opening free from interfering structures which tend to ward off more active pelagic animals.

W. J. D.

THE ANTHROPOLOGICAL SURVEY OF CANADA.

THE Dominion of Canada is the first of our colonies to have an official department for the sole purpose of anthropological investigation, and it is to be hoped that this good example will be followed speedily elsewhere. The history of this new departure is briefly as follows.

When the British Association met at Montreal in 1884, a committee, consisting of Dr. E. B. Tylor, Dr. G. M. Dawson, General Sir J. H. Lefroy, Dr. Daniel Wilson, Mr. Horatio Hale, and others (the personnel of which was subsequently modified), was appointed for the purpose of investigating and publishing reports on the physical characters, language, industrial and social condition of the north-western tribes of the Dominion of Canada. The twelfth and final report of the committee was presented at the Bristol meeting in 1898, which, in addition to original articles, contained a summary of the work of the committee in British Columbia by Dr. F. Boas, and an index to reports iv.–xii. In view of the meeting of the association in Toronto in 1897, a new committee, consisting of several Canadian and British members, was appointed at the Liverpool meeting in 1896 "to organise an ethnological survey of Canada," of which Dr. George M. Dawson was chairman and secretary. Prof. D. P. Penhallow was elected chairman in 1899. The committee suffered a great loss by the death of Dr. Dawson in 1901; he was succeeded by Mr. C. Hill-Tout. Prof. J. L. Myres, in his presidential address to Section H at Winnipeg, gave a short history of the work of the two committees, and stated that "the premature death of George Dawson in 1901 broke the mainspring of the machine: the field-workers fell out of touch with one another and with the subject; the instruments were scattered, and in 1904 the Ethnographic Survey Committee was not recommended for renewal." Thanks mainly to the energy of Prof. J. L. Myres and Mr. E. S. Hartland, a third committee was appointed at Winnipeg, 1909, with the Rev. Dr. G. Bryce as chairman and Mr. Hartland as secretary. The Ethnographic Survey Committee reported at the Sheffield meeting in 1910 (Report, p. 265) that its work had been crowned with success. The recommendations of this committee at the Winnipeg meeting to the Dominion Government were supported by delegations of the Canadian section of the Archæological Institute of America and the Royal Society of Canada, and on September 1, 1910, a division of anthropology under the Geological Survey of Canada was established, of which Dr. E. Sapir was made director. Dr. Sapir is a distinguished student trained by Prof. F. Boas. Dr. Boas is himself intimately acquainted with Canadian ethnology, and in 1888, under the auspices of the committee of the British Association, began his field-work among the north-west tribes which has led to such brilliant results. The inauguration of the new department could not have been put in better hands, but the work was clearly too vast for one man to cover it. On January 1, 1911, Mr. C. M. Barbeau, a very promising Canadian

who had been trained at Oxford, was appointed assistant in anthropology, and on June 15 Mr. Harlan I. Smith, formerly of the American Museum of Natural History, New York, entered on his duties as archæologist. Mr. Smith is well known as a keen and conscientious archæologist who has done some good work in British Columbia and elsewhere. The Canadian Government deserves hearty commendation for its appreciation of the need of an anthropological survey of Canada, and of the excellent selection of a staff with which to carry it out. May we be permitted to hope that at no distant date the services of a physical anthropologist will be secured?

It is true that a certain amount of work has already been done in Canada; but it has been of a sporadic character, and without any system, except that done by the Jesup North Pacific Expedition; attention should, however, be directed to the series of papers on the Salish tribes published by Mr. Hill-Tout, mainly due to the action of the British Association Committee, and to the fine monograph on "The Great Déné Race," by Father A. G. Morice, in *Anthropos*, vols. i., ii., iv., v. Dr. Sapir is fully aware of this; and while investigations of limited areas and peoples must first engage the attention of the small staff, he has already mapped out the problems which have to be solved, and thus the detailed work will fill gaps in a well-thought-out scheme. The best general account we have of Canadian ethnology is the valuable Archæological Report, 1905, printed by order of the Legislative Assembly, Toronto, 1906.

In a report published in *Science*, December 8, 1911, Dr. Sapir says:—"The ethnological work already undertaken by the division embraces three distinct lines of inquiry. The first of these was undertaken by [himself] among the Nootka, and resulted in the amassing of much material of linguistic and ethnological interest. It is intended to carry forward this work from year to year. The second line of inquiry is the analysis of the culture of the Iroquois, including under this term the Huron-Wyandots, who were never included in the league. This work was undertaken by Mr. Barbeau, who, beginning with the Hurons of Lorette and the few Wyandots still left in western Ontario, took up an intensive study of the most conservative group of Wyandots, those of Oklahoma. The study of the Iroquois proper, particularly from the point of view of social organisation, was entrusted to Dr. A. A. Goldenweiser, of Columbia University, who has amassed much of value at Grand River Reserve. The third point of attack was the culture of the eastern Algonkin tribes. Here a beginning was made by Dr. Cyrus MacMillan, of McGill, among the Micmac, and by Mr. W. H. Mechling among the Malecite. It is hoped to begin systematic work among the Cree, Ojibwa, Plains tribes, and tribes of the Plateau-Mackenzie region as soon as opportunity will permit. So far, the archæological work of the division has been confined to a preliminary reconnaissance, by Mr. Smith, of the field in eastern Canada. Hand-in-hand with research and publication, which must naturally form the main activity of an anthropological survey of Canada, is the building up of an anthropological section of the national museum at Ottawa. At present the museum is relatively rich in West Coast ethnological and Ontario archæological material, to the neglect of other fields. Persistent efforts are now being made to round out the resources of the museum.

"The Canadian Government is to be congratulated on having established a systematic survey of aboriginal Canada. Now or never is the time in which to collect from the natives what is still available for study. In some cases a tribe has already practically given up its aboriginal culture, and what can be obtained is merely that which the older men still remember or care to impart. With the increasing material prosperity and industrial development of Canada, the demoralisation or civilisation of the Indians will be going on at an ever-increasing rate. No short-sighted policy of economy should be allowed to interfere with the thorough and rapid prosecution of the anthropological problems of the Dominion. What is lost now will never be recovered again."

This is a very good example of the way in which the overseas meetings of the British Association justify themselves.

A. C. HADDON.

SOOT.[1]

THE smoke nuisance, like certain other public abuses, is rapidly approaching the acute phase which seems necessary before the patient town dweller changes his tone from an inarticulate murmur to a muttered complaint sufficiently loud to awaken the slumbering authority to a sense of his duty.

The smoke abatement societies serve as his mouthpiece; they have been formed to collect information, hold conferences, organise exhibitions of smoke-preventing appliances, and generally to create discontent with the present whilst encouraging hope for the future.

These societies have recently banded themselves together into a Smoke Abatement League, one of the objects of which is to persuade the Local Government Board to modify the present method of dealing with smoky chimneys. If statistics furnish any guide for public action, the League has fully justified its aims. Within the last few months facts have been forthcoming from different and quite independent sources showing not only the nature of soot and its effects, but the actual amounts discharged into the air and falling to the ground in the course of the year. These quantities are not reckoned in cwts., but in hundreds and thousands of tons.

Messrs. Cohen and Ruston have shown that the quantity per square mile which falls in Leeds increases from 25 tons on the outskirts to 539 tons in the industrial centre of the town. In London, Messrs. Des Vœux and Owens have found the quantity to vary from 58 tons at Sutton, in Surrey, to 426 tons in Old Street, E.C., and Mr. Fyfe, of Glasgow, in a paper read at the Manchester Smoke Abatement Conference, has found that whereas 72 tons falls at the seaside village of Bo'ness, the amount in Glasgow reaches about 820 tons per square mile. The three large towns together show a total deposit of nearly 50,000 tons of soot a year, or about 18 lb. per head of the population ($6\frac{1}{4}$ millions). At the same rate the yearly sootfall for the whole of the United Kingdom would reach about 300,000 tons; but this number is probably too high, as it includes country districts where naturally the quantity per head is much smaller. The method for estimating the deposit which has been used in Leeds was to collect rain water at eleven different stations (ten in the town and one in the country) by means of a large funnel placed in the neck of a Winchester quart bottle, and to analyse the contents monthly during a whole year. These estimations included the soot (in which the content of carbon, tar, and ash was determined) and the soluble constituents, viz. free and albuminoid ammonia and nitrates, free and combined sulphuric acid, sulphurous acid and chlorine. In Glasgow the deposit was estimated by means of eighty-three dust boxes, sixteen being distributed about Glasgow and the remainder placed in other districts. They were left for two months (December, 1910, and January, 1911), and the contents were then weighed and analysed for carbon, tar, and ash. Messrs. des Vœux and Owens have used a similar method to that adopted in Leeds, but on a much larger scale, substituting for the funnel a large hopper connected with a capacious bottle. The contents were treated as in Leeds, both insoluble and soluble constituents being estimated. The experiments were also continued throughout the year. There does not seem to be any great advantage gained by the substitution of the larger and more costly apparatus for the funnel and Winchester quart bottle if the analyses are carried out with sufficient care.

In addition to the monthly sootfall, the Leeds experiments have included the estimation of the total soot discharged from domestic and factory chimneys, and the still more important permanent deposit of tar, which is the prime agent in the discoloration of buildings and foliage, and (on account of its acid character) in the destruction of masonry, mortar, fabrics, and vegetation. The quantity of soot produced in Leeds annually from factory and domestic chimneys is roughly 35,000 tons, which is distributed as follows:—

[1] "Soot: its Character and Composition." By Cohen and Ruston. (Journ. Soc. Chem. Ind., December 15, 1911.)
"Air Pollution in Glasgow and Other Towns in Scotland." By Peter Fyfe. Paper read at the Manchester Smoke Abatement Conference, November, 1911.
"The Sootfall of London." (*The Lancet*, January 6, 1912.)

		Tons.
Blown away	...	31,480
Temporary deposit in the town	...	3,472
Permanent deposit in the town	...	48
		35,000

The method of determining the permanent deposit was by means of glass plates a foot square, which were exposed at different stations for three months at a time. The surface was then rinsed with water to remove any loose material, and the deposit removed and analysed. As this tarry material is much the most deleterious ingredient of the soot, the method of comparing the translucency of these plates after exposure with certain standards may be recommended as a rough test of atmospheric pollution by smoke.

Cohen and Ruston have calculated that in a domestic fireplace about 6 per cent. of the fuel escapes as soot, whereas in a boiler or other furnace the loss may be reckoned at $\frac{1}{2}$ to $\frac{3}{4}$ per cent. Taking the estimated coal consumption from both sources, we get for the whole country a loss in the form of soot of:—

	Tons
6 per cent. on the estimated domestic consumption of 32 million tons ...	1,920,000
0·5 per cent. on the estimated factory consumption of 100 million tons ...	500,000
	2,420,000

From the ratio of soot emitted to soot deposited in Leeds, the above 2,420,000 tons will yield a deposit of nearly 300,000 tons in the neighbourhood where the coal is consumed; for it must be remembered that the whole quantity will sooner or later reach the earth.

Comment is unnecessary. On the ground of the discomfort, dirt, waste, and pecuniary loss which smoke entails, the evil is one which should receive serious consideration, and it is to be hoped that the forthcoming conference and exhibition which is being promoted by the London Coal Smoke Abatement Society will be successful in directing more attention on the part of the authorities to the disastrous effects of smoky chimneys.

J. B. C.

BELGIAN BOTANICAL INVESTIGATIONS.[1]

THE supplementary part of the seventh volume is entirely occupied with a sketch of the geographical botany of Belgium by Dr. J. Massart, providing a continuation of the more specialised account of the vegetation of the littoral and alluvial districts by the same author published in the original volume, and previously noted in NATURE. The sketch does not contain any such detailed observations as are recorded in the botanical surveys carried out in Great Britain by W. G. Smith, C. E. Moss, and others, but incorporates the results of various Belgian researches, notably the modification of leaves in dry and moist localities furnished by Miss M. Ernould, the periodic phenomena of vegetation carefully studied by the meteorologist, Dr. E. Vanderlinden, in connection with climatic variations, as well as several geological and agricultural investigations. Geology occupies a more prominent position than is usual in an œcological botanical memoir, and practically supplies the basis of treatment in the most important chapter. The classification of associations is artificial. Uncultivated and cultivated areas are placed in antithesis. As might be expected in a country where mountain ranges are wanting and intense cultivation is general, there are few natural associations; apart from the dunes, the most important are the types of vegetation growing on cliffs and rocks.

A notice of Dr. Massart's able contribution would be quite incomplete without an expression of cordial admiration of the excellent photographs and maps that are collected in the "Annexe." Of the photographs, more than half are stereoscopic, and to ensure that they shall be fully appreciated a simple but effective stereoscope is provided. It will be observed that the author has paid particular attention to the photography of cryptogamic plants; fungi are the most suitable for the purpose, but the lichens (Figs. 434 and 636), the mosses (Figs. 332 and 414), and the algæ (Fig. 222), also the mycorrhiza of beech (Fig. 320), are particularly well defined. Discrimination between the photographs of flowering plants would be idle where nearly all are successful and convey their special meaning.

The eighth volume contains three extensive papers, a study by Dr. V. Gallemaerts of the phanerogams growing on willows, an investigation by Mrs. J. Schouteden-Wery as to the factors which regulate the distribution of algæ off the south-western region of the Belgian shore, and the observations of Dr. Vanderlinden mentioned above; in the last the observations, concerned chiefly with the comparative dates of flowering, extend over a period of fourteen years.

[1] "Recueil de l'Institut Botanique Léo Errera (Université de Bruxelles)." Publié par Jean Massart. Tome Supplémentaire vii.bis, pp. xii+332. Annexe au tome supplémentaire vii.bis, pp. iv+466 photographs+9 maps +2 diagrams+pp. v-xiii. Tome viii., pp. ix+383, avec Stéréoscope. (Bruxelles: Henri Lamerton, 1910 and 1911.)

BIOLOGICAL STUDIES IN JAVA.[1]

THE memoir referred to below contains a series of articles embodying the results of six months' study and observation in Java in the winter of 1909–10. The subjects dealt with are:—(1) climbing organs within the genus Randia; (2) Javan Myrmecodia; (3) the "silverfield" of *Haplochilus panchax*; (4) the microbiological processes in the humus of certain humus-collecting Epiphytes; (5) the bacteria nodules on the leaf-margins of *Ardisia crispa*.

Not the least interesting is the account of the author's investigation of the biological phenomena of *Myrmecodia tuberosa*, of *Hydnophytum montanum*, and, incidentally, of *Polypodium sinuosum*. Miehe briefly reviews the work of his predecessors, Beccari, Treub, and others, on the same subject, and adds a bibliography relating specially to the interrelations of ants and plants. The tuberous-stemmed rubiaceous genera Myrmecodia and Hydnophytum are among the most remarkable vegetable productions of the Malay Archipelago, alike in habit of growth and the economies of nutrition. These plants are epiphytes, usually gregarious, and commonly associated with the equally singular *Polypodium sinuosum*. They form irregularly shaped fleshy stems or tubers, ultimately 6 to 9 inches or more in diameter, with chambers and intersecting or blind galleries, in nature perhaps eventually always inhabited by a certain kind of ant and a fungus. A few short branches bearing a tuft of crowded leaves are given off from the tuberous stem, and the flowers are small and inconspicuous.

How far the association of these three organisms is an instance of beneficial symbiosis is still uncertain. Beccari, one of the earliest investigators and illustrators of this class of plants, came to the conclusion that the shape and development of the stems was entirely dependent on the action of the ants. But Treub proved by experiments with seedlings and older plants that the development of the thickened stems and the formation of galleries was absolutely independent of the ants. Hence some other use had to be sought for the passages and chambers open to exterior influences. Treub and subsequent investigators claim to have proved that these interior surfaces, which are of two kinds, play an important part in the economy of the plant, furnishing, in effect, the channels of absorption and transpiration. The absence of stomata from the exterior parts of the stem and tuber is advanced in support of this theory.

Miehe instituted further experiments to determine the nature of the vital functions of these two different surfaces of the galleries and chambers. In certain parts of the system the surface of the walls was smooth and of a "leather-yellow," in others black and warted. The result of numerous experiments was the same, namely, that the warty surface rapidly absorbs water, whereas the smooth surface does not possess this property. The fungus which inhabits the tubers has not been determined, but it is probably allied to Cladosporium and Cladotrichum.

[1] "Javanische Studien." By Hugo Miehe. Pp. 299–431. (Des xxxii. Bandes der Abhandlungen der Mathematisch-Physischen Klasse der Königlichen Sächsischen Gesellschaft der Wissenschaften, No. iv.) (Leipzig: B. G. Teubner, 1911.) Price 6 marks.

It is always present, and confined to those parts of the walls of the labyrinth which are studded with warts, there forming a dense carpet, which gives the dark colour to the walls. The ant, *Iridomyrmex myrmecodiae*, which inhabits the tubers under natural conditions is a small red one, but this was dispossessed by a larger black species in plants under cultivation in the garden of Buitenzorg.

The two kinds of wall-surface are thus briefly characterised:—"One part is smooth, light brown, impervious to water, free from fungus, and on which alone the ants place their pupæ; the other part is warty, discoloured, pervious to water, clothed with fungus, and never bears pupæ." Further, the ants deposit their excrement exclusively in the fungus galleries, so that the breeding part is kept pure and clean. Although a system of galleries and chambers is developed under artificial conditions independently of ants, the association of the three organisms points to a beneficial symbiosis whereby nutrition of the host plant is supplemented and the ants are provided with a home.

W. BOTTING HEMSLEY.

THE STUDY OF DAYLIGHT ILLUMINATION.[1]

PROF. L. WEBER has lately published an account of the series of tests of daylight illumination carried out by him in Kiel during the years 1905–8. Measurements of this kind were previously undertaken and described by the author so far back as 1890; his main object on this occasion has been to devise a more accurate and convenient means of specifying daylight illumination and the requisite window-area in interiors.

The results of a new and complete series of measurements of light from the unrestricted sky, carried out at mid-day, classified for the months of the year and extending over the years 1905–8, are now given. The author also describes an improved form of photometric apparatus specially devised for this work. The results of an extensive series of tests of the day-illumination in the State schools at Kiel are also presented. At the time of previous experiments the individual characteristics of the various class-rooms and the prevailing climatic conditions had not been sufficiently correlated, so that it was difficult to frame very precise general recommendations. Prof. H. Cohn has, however, suggested that the illumination on any desk should not fall below 25 metre-candles (approx. 2½ foot-candles), and that this result would in general be secured if the projected solid angle subtended by the window-area at this desk was not less than 50 square degrees.

This solid window-angle is often taken as the sole criterion of effective illumination. Yet it leaves out of account the effect of reflection from the walls in the room, and also the position of the window with respect to the surroundings outside.

An improvement now suggested by Prof. Weber takes the form of measuring the "light-value" (Lichtgüte) of the window. This quantity denotes the value of the projected area of the portion of the window-area which is entirely unobscured by surrounding trees or buildings, the area of the entire window being taken as 100. Prof. Weber describes two new instruments for the convenient measurement of these quantities.

Authorities, in estimating the daylight requirements of a room, usually require that the ratio of the window-area to the floor-area of the room should not exceed 1 : 6, or in some cases 1 : 10. The author suggests that if this ratio were multiplied by the "light-value" we should get a much more serviceable factor (which he denotes by P) for expressing the admission of light to the room.

Further data are needed before one can state quite definitely what value P should assume for various interiors, but this information could readily be obtained. As an illustration the author summarises the results of tests in 520 typical class-rooms, the illumination on the best and worst illuminated desks, and on a desk intermediate between these extreme positions, being studied. For 171 of the rooms P had a value >10, and in 304 rooms it was >5 but <10. In conclusion, he estimates that in only 5 per cent. of these class-rooms would the illumination, under average climatic conditions, during the year fall below Cohn's minimum of 25 metre-candles.

Prof. Weber next gives an account of his examination of the conditions of illumination in the library of the University of Kiel. He shows that, so far from complying with Cohn's minimum figure, even the best lighted tables would only receive 2–3 metre-candles during December. He also points out that the rule prescribing the window space for a given floor-area is quite inapplicable to rooms in which the floor is filled by vertical stacks of books, and that such shelves rarely receive sufficient light.

Finally, there is a communication from H. Borchardt which contains a summary of the theoretical and experimental methods employed for studying the distribution of brightness in the sky. A chart (based on a method devised by Prof. Weber) is given showing the approximate intensity and distribution at different periods of the year. The sky rarely approaches the ideal diffusely radiating hemisphere assumed in conventional calculations. The illumination is really due to mixture of diffused and transmitted light, the proportions of which vary with different climatic conditions. The distribution of brightness alters accordingly.

[1] A reprint from the *Schriften des Naturwissenschaftlichen Vereins für Schleswig-Holstein*, Band xv., Heft i.

THE FLORA OF DAGHESTAN.

MR. N. I. KUZNETSOF concludes an article in the *Izvestiya* of the Imp. Russ. Geogr. Soc., Nos. 6–7, 1910, on the flora of the mountain region of Daghestan, with an historical sketch of its origin and distribution. Daghestan was raised above the water at the beginning of the Tertiary period, and its climate subsequently became drier and assumed a more continental character as the Sarmatic Sea around it dried up, and consequently the Tertiary forest which clothed it must have gradually dwindled. At the same time, the combined action of erosion and tectonic movements produced bare slopes, which, especially those facing south, afforded excellent conditions for the development of upland xerophytic vegetation. Here gathered forms which had existed in various parts of Daghestan from the beginning of the Tertiary period, and were now distributed, some in the north, others in the south, some on the schists, others on the limestones, and in connection with climatic conditions.

In the Glacial period Daghestan received fresh accessions from the north, and from the west through Asia Minor. Firs and birches now clothed the country, crowding out what was left of the Tertiary timber trees, which are now represented only by an occasional Tertiary birch, *Betula Raddeana*, or oak, *Quercus macranthera*. Many slopes, especially the southern, were never forested, and many limestone plateaus would not harbour arboreal vegetation, and there xerophytic types spread vigorously.

In the steppe period the forest trees retired into the heart of the country, their place being taken by xerophytic forms, while in the open valleys appeared representatives of the hot desert flora of the Mediterranean. The mountain xerophytic forms of Daghestan spread widely during this period. Some forms, not adapted to migration, remained in the country, others spread to other parts of the Caucasus, while those easily distributed extended so far as the steppes of South Russia, when these were laid bare by the retreat of the Pontic Sea. Maps accompanying the article show the distribution of the most characteristic forms.

VITAL EFFECTS OF RADIUM AND OTHER RAYS.[1]

ADOPTING the chronological order in which the radiations of radium and other sources were discovered and applied, the lecturer considered, in the first place, the effects of light and radiant heat, dwelling especially upon the fact that the chemical rays—*i.e.* blue, violet, and ultra-violet—were those which had vital effects upon the tissues. The differential effect of these rays as compared with those of longer wave-length at the other end of the

[1] Abstract of a discourse delivered at the Royal Institution, on February 2, by Sir James Mackenzie Davidson.

spectrum was well brought out in the course of an experiment in which, the spectrum having been produced upon the screen, a strip of bromide paper was stretched across it so as to receive the length of the spectrum, and this on being developed and fixed was shown to have darkened very considerably at the blue and violent portion, while the red end of the spectrum was practically white paper. The more ready absorption of these blue and violet rays, known to everyone who has looked at the reddened disc of the sun through a somewhat dense fog, was further illustrated by placing a glass cell in front of the lantern and filling it with hypo solution to which some hydrochloric acid was added. Ultimately, only the red waves were able to penetrate. The lecturer further pointed out that the blue colour was the last to be seen at the close of day; that when a person had his sight temporarily impaired by over-indulgence in tobacco he lost the perception of red and green in the centre of his field of vision, but very rarely lost the perception of blue; and that in cases of blindness coming on gradually from wasting of the optic nerve, blue was the last colour to go.

After reviewing the Finsen light treatment, which was based upon the fact that the most effective rays, physiologically speaking, were those of the violet and ultra-violet, and the superseding of the arc by a quartz mercury vapour lamp for the production of active violet light in large quantities, the lecturer turned to the X-rays, and spoke of the early X-ray burns sustained by operators, paying a tribute to Dr. Blacker, of St. Thomas's Hospital, one of the first martyrs in radiology. Sir James proceeded :—

"It is worthy of note that most, if not all, X-ray burns produced in operators began in the uncovered parts of their skin, such as the hands and face. A good deal of doubt still exists as to whether the primary X-rays alone are responsible for these manifestations. Having suffered from chronic X-ray burns in my hands, especially my right hand, it seemed to me rather remarkable that the area of trouble at the back of the hand should end sharply at a line corresponding to the usual position of the coat-cuff, for cloth, of course, is quite transparent to the X-rays, and the adjacent parts of the skin beneath the sleeve were in my own case equally exposed with the uncovered hand itself.

"Many views have been put forward to explain the causation of certain of the X-ray burns, but it appears probable that the secondary or indirect rays given off from the surface of the glass may be, if not in some cases the primary factors, certainly largely contributory to these superficial skin burns. As a further confirmation of the possibly vital effect of these rays upon the skin, I may mention that Freund, of Vienna, found that a tube so high as to give no fluorescence on the screen caused the hair to fall out, and also that, with a tube having the electric current passed in the reverse direction so as to produce only very weak primary X-rays, similar results were obtained. It would be interesting to construct a tube so as to employ for therapeutic purposes these secondary rays alone."

The lecturer demonstrated the existence of these secondary and less penetrating rays by exciting a Crookes tube in the ordinary way, and suspending opposite the point from which the primary rays emerge a mass of lead through which no primary or direct X-rays could possibly penetrate. Naturally, a shadow of the lead was cast by the X-rays coming from a fine point in the anode—the X-rays which may, for the present, be called the primary rays—but within this eclipsed area he obtained shadows caused by other rays, and when these were traced they were shown to be produced on the glass of the tube, which fluoresced green. These rays, he found, were more richly produced in what was called a "high" or "hard" tube. On making comparative measurements of the rays by means of the electroscope, he found that with a high tube giving very penetrative rays, if the action of the primary rays were taken as 1, the action of the secondary rays would be ½, and that with a low tube giving X-rays of a low order of penetrability, if the primary rays were again taken as 1, the secondary rays would be one-seventh.

The work done upon these secondary rays from the physical side is comparatively slight. Mr. Campbell Swinton alludes to their existence in a paper published in 1898, when he describes them as secondary rays from the green fluorescing glass of the X-ray tube; and at a somewhat earlier date Prof. Silvanus Thompson showed that the kathode stream, after impinging upon the target and thus giving rise to the main beam of X-rays, was reflected and impinged upon the glass walls of the tube, thus causing a green fluorescence. He called these reflected kathode rays "para-kathodic." "Whether they produce X-rays upon this second impact or not does not appear to have been proved," said Sir James Davidson in concluding this portion of his lecture, "but as Barkla and Sadler and others have demonstrated that X-rays outside the tube, impinging upon solid matter, give rise to secondary rays, it seems certain that the X-rays, in passing through the walls of the tube in which they are generated, must give rise to secondary X-rays, and it may well be the case that the green fluorescence of the glass of an X-ray tube gives us two sets of X-rays—one produced by the primary X-rays in their impact on passing through it, and the other produced possibly by reflected kathodal rays. Be that as it may—and it is a matter for the physicist—I feel sure that their physiological action upon the skin must be considerable, especially as they are much more readily absorbed than the primary X-rays."

Discussing the methods of protection against X-ray burns, the lecturer said that many years ago he made an experiment in which a Crookes tube was completely buried in a large quantity of red lead contained in a box, and when this was excited in a dark-room the fluorescent screen showed that no X-rays at all were able to penetrate. Then a small opening was made by scooping away the red lead until the primary rays got through, together with only a very few of the secondary rays from the small area of glass opposite the orifice. This was the most effective means of screening everybody from the rays except the individual under observation, but it was highly inconvenient, the apparatus being difficult to handle, especially when a fresh tube had to be embedded. Therefore a box was constructed, lined with a mixture of red and white lead, and a small hole was cut in it for the emission of the rays. Some such method, he added, was now generally adopted, and was most important for the protection of the workers. The lining of the fluorescent screen with thick lead-glass, and the Sabouraud pastille method of dosage, with other safeguards, rendered the X-rays, as applied for medical purposes, practically free from risk to operator and patient alike.

The lecturer then proceeded to describe the effects of X-rays upon cell-life, pointing out their radical influence upon the young and growing tissues. On the principle of attacking the young and growing cells, the X-rays injured the hair follicles and brought about the fall of the hair. The sweat glands could be destroyed in the same manner. The action of the X-rays upon the blood was limited chiefly to the white blood corpuscles, the red blood corpuscles being very resistant. The central nervous system also, fortunately, had great resisting capacity. The most sensitive of all the tissues were the lymphoid tissues generally, especially the spleen, which shrank and became strongly pigmented under the attack of the radiation. Indeed, in certain diseased conditions of the spleen the X-rays had been used with marked success. In malignant tumours, while the X-ray method might be of service in checking the rapidity of the growth, it could not be looked upon as a method of cure, although after the removal of such growths by operation the application of the rays to the involved area might assist in destroying any of the malignant cells which the surgeon's knife had missed, and thus preventing redevelopment. As the technique of the X-rays improved, the field of their utility in therapeutics would be gradually extended.

Next in order to the X-rays, historically, came radium. The events which led up to the discovery of this substance were summarised, and the physical properties of radium were described. The process of the disintegration of the radium atom, through which was evolved the radiant energy of such service in medicine, was admirably illus

trated by the very simple experiment of burning some magnesium sparking compound. In this process of flying to pieces the radium atom first gave off an atom of helium which was called the α ray, and the remainder of the atom evolved as a gas or emanation. The emanation in its turn decomposed, losing half its energy in about four days, and finally gave rise to an active deposit of rapid change, which gave off α, β, and γ rays. The action of the α rays on living cells was uncertain, but from some experiments which the lecturer had carried out with the "active deposit" from thorium he thought that the action of these rays upon the skin must be very slight.

The biological effects of radium had been closely studied upon a large variety of organisms. In the case of plants, for instance, a tube of radium placed upon a leaf would cause the irradiated area to lose its chlorophyll and to assume autumn tints. A prolonged exposure retarded the growth of seeds. Anthrax microbes had been found not to develop at all if left for twenty-four hours in an atmosphere charged with radium emanations. In Metchnikoff's laboratory at the Pasteur Institute, recently, it had been proved that certain toxins tended to lose their virulence after being made radiferous. When diphtheritic toxin was left for thirty days in contact with minute quantities of radium sulphate, the poisonous effect of the toxin was found to be much less rapid than in the case of the same toxin which had not been treated in this fashion. Young animals were particularly sensitive, especially in the epithelial tissues, and when animals had been killed by exposure to radium it was worthy of remark that paralysis and death were found to be due to internal hæmorrhages. The nerve cells had not shown any appreciable alteration. The central nervous system in all cases, indeed, was very resistant to radium action, but it suffered indirectly from the effects upon the vascular tissues.

"The date of my own first application of radium to the treatment of disease," continued the lecturer, "was May, 1903. The case was a large rodent ulcer, just below the right eye, which was rapidly progressing in spite of X-ray treatment. Two glass tubes, each containing 5 mg. of radium bromide, were applied tentatively for a short time to the upper border of this ulcer, and the application was cautiously repeated in the course of two or three days. The improvement was so manifest that the tubes were applied in the same manner over the general surface of the ulcer, which finally healed perfectly without scarring, and has remained well during the nine years that have since elapsed." While incapable of effecting a cure in certain severe and old-standing rodents, their progress was arrested in a marked manner, and considerable improvement of the condition was gained. "Radium has also proved to have a markedly specific action upon a troublesome disease of the eyelids known as 'spring catarrh.' This occurs in young people, the upper eyelids more particularly being covered with rough granulations. The disease was quite incurable until I applied radium to a little boy sent to me by Mr. Arnold Lawson, and with the use of radium every case treated has been completely and painlessly cured. A matter also worthy of remark is that from the commencement of the treatment, even before any appreciable improvement is visible, the patients express themselves as feeling the eyes much more comfortable, and they are able to use them in their ordinary occupations during the period of treatment.

"A further indication for radium therapy was discovered in the case of X-ray dermatitis. It was my misfortune to suffer from a chronic manifestation of this trouble, and three or four years ago a burnt patch on my hand became ulcerated. One portion was so threatening as to suggest malignancy, which is, unfortunately, a common result of these lesions. As nothing that was tried would effect a cure, it became a question of excision; but before resorting to this I applied radium in glass tubes, and was agreeably surprised to find that it completely cured the condition. The tube contained 20 mg. of pure radium bromide, and was left in position for twenty-five minutes. Nothing happened for twelve days, and then there occurred a certain amount of swelling and redness, the size of the black crust increased, and serum exuded from the side. This gradually subsided, and when the crust peeled off the normal healthy thin skin was found to be beneath it." Some striking photographs illustrated successively the dermatitis, the radium tube in position, the reaction, and the disappearance of the spot.

The lecturer went on to describe the apparatus for spreading radium, for enclosing it in tubes of metal and embedding it in the tumour, and for its metallic filtration so as to obtain a desired penetrability of ray. Some diseases yielded to radium more readily than others. Lupus was very resistant, but a great many other skin diseases, as well as *small* cancers of the tongue and lip, could be cured, while large, rapidly growing tumours like sarcoma could be cured by the method of burying tubes within them. Here, again, the fact was illustrated that these rays seemed to concentrate their attack upon young and most rapidly growing cells. That was probably the reason why sarcomas were so vulnerable to attack when compared with carcinomas, which were of slower growth. But in spite of its greater potency and convenience in application, the same thing had to be said of radium as was said of the X-rays—that it could not in any sense be looked upon as a cure for cancerous growths of large size. It would inhibit the further growth of such tumours, and even destroy them locally, but rarely completely, and it did nothing to prevent the usual secondary deposits. In the diseases for which the rays possessed curative properties, their action was extraordinarily selective, so that, if the dosage were well timed, they would destroy the abnormal cells without destroying the normal.

The effect of the emanation of radium, which when dissolved could be injected into the tissues, or, like the salt, could be confined in a metal tube and buried, was practically the same as with radium itself. The emanation gave 75 per cent. of the energy which would be obtained if the radium from which it came were embedded in its stead. When introduced into the system by inhalation, by injection, or by swallowing, the emanation seemed to have a capacity for stimulating the body ferments. He produced a standard for the radium emanation which had been given to him by Sir William Ramsay. It was in the form of a bottle containing 1/40,000th part of a milligram of pure radium.

In conclusion, the lecturer turned to the possibility of other radio-active substances, less forbidding in price and more readily available, taking the place of radium. Uranium, thorium, and actinium were radio-active, and had all been suggested in this connection, but they were too feeble to have any real efficacy. The discovery by Otto Hahn of a substance known as meso-thorium, which was one of the disintegration products of thorium, and was found in the course of an attempt to separate radiothorium directly from thorium, had aroused considerable expectation. Meso-thorium emitted the same rays as radium, and, weight for weight, was more powerful. As the supply of thorium was much larger than that of pitchblende, from which radium was obtained, they might hope to have a larger supply of meso-thorium. It would cost much less, but, on the other hand, it had a short life of only about seven years. It was being experimented with medically in Germany. The lecturer had applied a tube, which he showed, equivalent to 10 mg. of pure radium, to a chronic patch of X-ray dermatitis on his hand, and a reaction followed fifteen days after application. The result promised to be favourable.

Radio-thorium gave off thorium emanation richly. This was a heavy gas, lasting seventy-six seconds, giving off α rays in profusion—rays which, impinging upon a sulphide of zinc screen, caused it to glow or fluoresce, a remarkable "spinthariscope" effect being observed when the screen was viewed with a magnifying glass. Thorium emanation also resembled that of radium in giving rise to an "active deposit," this becoming concentrated on the negative pole in an electric field. A metallic surface could in this way be made intensely radio-active, giving forth the α, β, and γ rays. The "active deposit" from the thorium emanation lasted for several hours. The lecture concluded with a very pretty demonstration of the thorium emanation passing through long tubes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Plans are before the University for doubling the size of the present School of Agriculture, the increase being rendered necessary in order to cope with the large accession of work entailed by the proposed assignment to the Cambridge School of Agriculture of grants from the Development Commissioners for research in plant-breeding and animal nutrition. It is suggested that the new building should extend from the western end of the present school towards Tennis Court Road.

The Site Syndicate has recommended that a site on the south-east corner of the Downing College site should be assigned for the erection of a building for the Forestry Department. The area measures 110 ft. by 36 ft.

Dr. Graham-Smith has been appointed university lecturer in hygiene until September 30, 1916.

Dr. J. Ward, professor of mental philosophy and logic, has been appointed chairman of the examiners for the Moral Sciences Tripos, 1912.

SIR DAVID GILL, K.C.B., F.R.S., will present prizes and certificates to students of the South-Western Polytechnic Institute, Chelsea, on March 15, at 8 p.m. Laboratories and workshops will be open afterward to public inspection.

IT is announced in the issue of *Science* for February 9 that conditional gifts of 20,000*l.* to Washington and Jefferson College at Washington, Pa., toward a 100,000*l.* fund, and 10,000*l.* to the Emory and Henry College at Emory, Va., toward a 50,000*l.* fund, were voted at a meeting of the General Education Board of the Rockefeller Foundation last January.

MR. J. C. MAXWELL GARNETT, a son of Dr. William Garnett, educational adviser to the London County Council, has been appointed to succeed Mr. J. H. Reynolds in the principalship of the Manchester Municipal School of Technology. Mr. Garnett had a brilliant career at school and Cambridge, where he was a wrangler in 1902, in the first division of the first class of Part ii. of the Mathematical Tripos in 1903, and a Smith's prizeman in 1904. He was for some time connected with the technological branch of the Board of Education, but was later made junior examiner in the elementary branch. His interests are, however, on the technical and scientific side, and he should find Manchester a congenial sphere for the exertion of his activities.

THE report of the executive committee of the Carnegie Trust for the Universities of Scotland, presented at the annual meeting of the Trust held on February 22, points out that the past year completed the first decade of the history of the Trust. The total income for the period amounted to 1,062,931*l.*, out of which 63,546*l.* was expended on research, 368,288*l.* in grants to universities and colleges, 445,373*l.* in payments of class fees for 11,480 individual students, and 30,158*l.* in administration. The income last year amounted to 108,542*l.*, and the gross expenditure to 83,160*l.*, including 7833*l.* for endowment of research, 21,182*l.* for grants to universities and colleges, 50,525*l.* for payments to students, and 3620*l.* for administration. During the year the sum of 339*l.* was voluntarily refunded on behalf of fourteen beneficiaries for whom class fees had been paid by the Trust.

GIFTS amounting to 16,260*l.* have been announced, says *Science*, by the trustees of Columbia University, including 6000*l.* from Dr. William H. Nichols for instruction and research laboratories in chemistry, and 5000*l.* from Mrs. Russell Sage for the E. G. Janeway Library endowment fund at the medical school. From the same source we learn that Transylvania University has announced that the effort to raise a fund of 50,000*l.* has been completed successfully. The largest gifts, apart from 10,000*l.* offered by the General Education Board in May, 1910, were as follows:—6000*l.* from Mr. R. A. Long, of Kansas City; three gifts of 5000*l.* each from Messrs. W. P. Bowers, of Muncie, Ind., Geo. H. Waters, of Pomona, Calif., and J. J. Atkins, of Elkton, Ky. Our contemporary also states that the completion of the 100,000*l.* endowment fund for Oberlin College has made possible the following additions to the college resources:—the men's building, 30,000*l.*; a new administration building, 10,000*l.*; the completion of the men's gymnasium, 10,000*l.*; for higher salaries, 40,000*l.*; and other endowments, 12,000*l.*

WE regret to learn that the position of Hartley University College, Southampton, at the present time is extremely critical, and unless a further sum of 10,000*l.* is raised by April 1 it is to be feared that the college will lose its status as a university college for Hampshire, Wiltshire, Dorsetshire, and the Isle of Wight. This will mean a very serious setback to education in the south of England, especially in view of the rapid growth of secondary schools throughout the area, all of which look to Southampton as their university. Inspectors appointed by the Advisory Committee of the Treasury visited Southampton in 1909, and although their report was entirely satisfactory as regards the work and development of the college, and its educational value to the area which it is intended to serve, yet the buildings were condemned as inadequate, and attention was directed to the lack of voluntary local support. On these grounds it was proposed that the annual grant of 2250*l.* should be reduced to 1500*l.* for the year ending March 31, 1911, after which date the grant should be entirely discontinued. Eventually, however, as the result of representations made by the college, the full grant was paid, and was renewed for the year ending March 31, 1912, on the understanding that about 31,000*l.* should be raised by that date, to be apportioned approximately as follows:—(*a*) 5000*l.* for the purchase of the new college site; (*b*) 21,000*l.* for the erection of two blocks, to accommodate the arts department (including the day training department); (*c*) 5000*l.* to form the nucleus of an endowment fund. Strenuous efforts have been made to raise this sum, sixteen committees being formed in various districts, with the result that 15,962*l.* has been given or promised, while the college can dispose of property in Southampton estimated at 5000*l.*, making a total of 20,962*l.* An excellent site has been procured, and satisfactory plans for the new buildings obtained in open competition. The amount available is therefore about 10,000*l.* short of the sum required to be raised by April 1, and if this sum is not forthcoming the college must collapse. It has been the experience of almost all university colleges that once the early difficulties have been mastered the growth of the institution is rapid and its success assured. There is every reason to believe that the result will be the same at Southampton if the additional sum of 10,000*l.* can be secured within the limited time allowed. Donations will be gratefully received by Mr. D. Kiddle, The Registrar, Hartley University College, Southampton.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, February 7.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. A. H. **Cox**: An inlier of Longmyndian and Cambrian at Pedwardine (Herefordshire). The inlier comprises a strip of country about a mile in length and half a mile in breadth, situated near the border of Herefordshire and Radnorshire, about fifteen miles south of Church Stretton. Wenlock and Ludlow beds occupy most of the area around Pedwardine, but the occurrence of Cambrian Shale yielding Dictyonema has long been known. The Dictyonema Shales dip steeply westwards towards a series of red and green conglomerates and grits, with which an occasional thin shale-band is interbedded. The latter beds, previously mapped as Llandovery, are here referred to the Longmyndian. They also dip westwards, and have suffered disturbance, accompanied by overthrusting from the west. They are unfossiliferous, and neither on lithological nor on structural grounds can they be regarded as Llandovery strata resting unconformably upon the Cambrian. The grits at Pedwardine have apparently been carried south-eastwards over the Cambrian along an almost horizontal thrust-plane. There is also present a remnant of Bala grits, which dip gently eastwards, and rest with strong unconformity upon the Cambrian shales. The undisturbed character of these Bala beds suggests that the neighbouring thrust may be

of pre-Bala date. Later faulting along a north-and-south line has brought the members of these older formations against Wenlock and Ludlow beds. From the disturbed character of the Silurian strata to the west of the inlier it would appear that this inlier is part of a barrier which has preserved the district lying to the east from the effects of the post-Silurian movements.

Linnean Society, February 15.—Dr. D. H. Scott, F.R.S., president, in the chair.—R. H. **Compton**: An investigation of the seedling structure in the Leguminosæ. The tree habit is held to be primitive in the Leguminosæ, the herbaceous habit derived; these characters are correlated, respectively, with the production of large and small seeds, and therefore of large and small seedlings. A stable type of tetrarchy is correlated with large size of seedling, and is therefore probably primitive. Since both the type of symmetry and the level of transition are clearly related to the size of the seedling, it appears that, with certain possible exceptions, these anatomical features are not likely to be of more value in solving phytogenetic problems than the size-characters themselves.

Royal Anthropological Institute, February 20.—Dr. W. L. H. **Duckworth**: Cave exploration at Gibraltar during September, 1911. The excavations commenced by Dr. Duckworth in September, 1910 (*v.* NATURE, March 16, 1911, p. 100, and *The Athenaeum*, March 11, 1911), were resumed in September, 1911. In the first instance, a fissure near "Beefsteak Cave," Europa Flats, was explored. It yielded stalagmite-encrusted bones of a stag, together with comparatively recent bones of domestic animals, as well as those of seabirds and hawks. A cave on the Mediterranean aspect of the Rock was entered. This cave is marked "4*a*" in the illustration of Genista Cave, No. 4 in Dr. Busk's paper. Cave 4*a* yielded many bones, representing a long list of mammals and birds, but no human remains came to light. Attention was then directed to Sewell's Cave (cave S) on the Mediterranean side, which yielded so many bones in 1910. Sewell's Cave was not completely explored in that year, but has now been thoroughly investigated. The most interesting finds in 1911 are several very delicate flint implements, a human tooth and wrist bone, part of a shell armlet, fitting on to a corresponding fragment found in 1910, a specimen of the mollusc *Nassa reticulata*, and a bone which is almost certainly that of a leopard. Fragments of pottery were also collected. Holyboy's Cave was again visited (*cf.* Report, 1910), and the hip bone of a small bear was found there on the surface of the floor. Apart from work in the caves, the fissures opening near the galleries, and the talus near the King's Lines, were inspected, some cervine bones being found *in situ* in one fissure.—A. L. **Lewis**: Some prehistoric monuments in the departments Gard and Bouches du Rhone.

EDINBURGH.

Royal Society, January 22.—Dr. J. Burgess, vice-president, in the chair.—G. H. **Gulliver**: Note upon the structure of ternary alloys. During the second period of solidification of a ternary alloy the temperature is not constant, and some liquid is always present. The crystals of the two separating phases are, therefore, enabled to grow to an appreciable size, and instead of the fine structure of a eutectic they have the form, and nearly the size, of the crystals of the primary phase.—Dr. R. A. **Houstoun** and his associates continued their researches on the absorption of light by inorganic salts: No. v. (by Dr. **Houstoun**), copper and the alkali metals; and No. vi. (by A. R. **Brown**), the cobalt chloride colour change. The former paper gave the molecular extinction coefficient for aqueous solutions of thirteen salts in the ultra-violet, visible spectrum, and infra-red. The values for the infra-red were obtained with a thermopile, and those for the ultra-violet by a new photographic photometer. This, however, did not prove so successful as the photographic photometer used in previous work along with J. S. Anderson. Part of the apparatus was a mirror spectroscope of original design, with nickel mirrors and automatic focussing. In the experimental work described in the second paper, anhydrous cobalt chloride was dissolved in mixtures of alcohol and water, and twenty-three different solutions were prepared, the solvent varying from pure water to pure alcohol through well-graded intermediate mixtures. The optical measurements were made with a spectrophotometer throughout the whole visible spectrum. The results were discussed mathematically with the help of the law of mass action, and it appeared that in the red aqueous solution of cobalt chloride each molecule of salt was combined with about fifteen molecules of water. Quantitative work done with a solid cobalt hexahydrate bore out this view, the absorption spectrum of the latter being quite different from the spectrum of the solution.—W. J. **Crawford**: The elastic strength of flat plates. This was an elaborate experimental investigation on the elastic strength of clamped circular and rectangular plates subject to a definite hydrostatic pressure on the one side. The analytical theory for circular plates was verified, and the results for various forms of rectangular plate were compared with Grashof's formulæ, which are purely empirical and not in harmony with fundamental principles of the theory of elasticity. Grashof's formulæ for the maximum stress and deflection were fairly well satisfied, but the experimental strength as measured by the curvature did not agree very well with Grashof's expressions.—Dr. J. H. **Ashworth**: Observations on the structure and affinities of *Branchiomaldane vincenti*, Langerhans. This small Polychæte exhibits several points of resemblance to a young ecaudate Arenicola, but differs from the latter in the position of its gills and in its nephridia, of which there are only two pairs. The second nephridium of *B. vincenti* is elongate, and extends through three or four segments. Although Branchiomaldane presents some primitive characters, it affords evidence of having undergone considerable retrogression, no doubt correlated with its tubicolous habits.

CAMBRIDGE.

Philosophical Society, January 29.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—R. H. **Clarke**: Demonstration of a stereotaxic instrument for directing insulated or other needles to any desired point in an animal's brain by graduated movement in three planes.—E. **Hindle**: Observations on fowl pest. The author has shown that the offspring of *Argas persicus* infected with *Spirochaeta gallinarum* are also infected, producing spirochætosis in the fowls on which they feed. Moreover, the eggs laid by ticks reared in the laboratory, and which have always been fed on healthy fowls, are found to be infected. These observations show that once an Argas becomes infected, the infection is maintained not only in the first generation, but also in the second.—C. **Strickland**: Gregarines in fleas.—Major **Cornwall**: The relation between the lytic point of red corpuscles in hypotonic salt solutions and the tonicity of the serum expressed in terms of NaCl. The mean range of lysis of the red corpuscles was very nearly the same for all the species experimented with, the average of the eight being 0·144 per cent. NaCl. The majority of the red corpuscles of any particular species are lysed at or about a particular dilution of salt, and comparatively few are either much more or much less resistant than the majority. These variations probably depend on the strength of the envelopes of the corpuscles. There is no obvious relation between the resistance of the corpuscles of any species to hypotonic lysis and their resistance to lysis by normal serums of other species. No definite relation could be discovered between the resistances of the red corpuscles and the tonicities of the serums. The high tonicity of serum is probably apparent and not real, and is perhaps due to some protein.—C. **Warburton**: The genus Rhipicephalus. Attention was directed to the genus Rhipicephalus of the Ixodidæ as presenting quite unusual difficulties to the systematist. Of course, in any group forms are liable to occur concerning which it is difficult to decide whether they ought to be regarded as distinct species or merely local varieties, but the difficulty in subdividing the genus Rhipicephalus goes much beyond this. Two forms so distinct that—on the analogy of other genera of ticks—no one would hesitate to recognise them as different species, are found in two different localities, where each is fairly constant to its type, but presently a number of specimens are collected from a single animal in a third locality completely connecting the two; and this occurs over and over again. It is suggested that we have here a very striking case of species in the act of formation, before intermediate forms have had

time to disappear. The genus is essentially African. Only two or three so-called "species" of Rhipicephalus occur out of Africa, and their distribution is easily accounted for by the fact that they are dog parasites. The other principal Ixodid genera are well distributed all over the world.—Prof. **Nuttall**: The parasites of equine biliary fever. Prof. Nuttall described the two species of parasites, *Piroplasma caballi* and *Nuttallia equi*, which occur in equine biliary fever in Africa, Asia, southern Europe, and South America. It has hitherto been supposed that biliary fever is due to but one species of parasite, but studies carried on in conjunction with Mr. C. Strickland have demonstrated that two diseases, due to distinct parasites, have hitherto been confused under one name. Both parasites are very deadly in their effects; they are transmitted from horse to horse by ticks, and the blood of animals which have recovered from all symptoms of the diseases remains infective for years.

MANCHESTER.

Literary and Philosophical Society, February 6.—Prof. F. E. Weiss, president, in the chair.—William **Burton**: Note on the earliest industrial use of platinum. The author gave an account of the general history of the mineral, particularly its use for coating pottery, and he exhibited specimens of pottery illustrating the application of various metals.—Prof. E. **Rutherford**: The origin of the β rays from radio-active substances. He stated that from a study of radio-active transformations it has been found that each atom of matter, in disintegrating, emits one α particle expelled with a definite velocity, which is characteristic of the substance. In many transformations, β and γ rays are emitted, and from analogy it would be expected that one β particle should be emitted for the transformation of each atom. The experiments, however, of Baeyer, Hahn, and Miss Meitner, and of Danysz, have shown that the emission of β rays from the radio-active substances is, in most cases, a very complicated phenomenon. The complexity of the radiation is most simply shown by observing in a vacuum the deflection of a narrow pencil of β rays by a magnetic field. If the rays fall normally on a photographic plate, a number of sharply marked bands are observed, indicating that the rays are complex, and consist of a number of homogeneous sets of rays, each of which is characterised by a definite velocity. The remarkable complexity of the β radiation is well instanced by the experiments of Danysz, who found that the products of radium B and C together emitted at least twenty-seven sets of homogeneous rays. Some of these had a velocity exceedingly close to that of light. Notwithstanding this apparent complexity, general experiments have shown that the number of β particles emitted from radium B and C is about that to be expected if each atom in breaking up emits only one β particle. In order to explain this complexity of the β rays, it is necessary to suppose either that the atom breaks up in a number of distinct ways, each of which is characterised by the emission of rays of definite velocity, or that the energy of the β particle can be reduced by certain definite amounts in its escape from the radio-active atom. The latter view appears more probable and more in accordance with the facts observed. It was found from an analysis of the results given by Danysz that certain relations existed between the energies of the individual β particles composing some of the different sets of rays. The difference in the energies of the β particles from radium B and from radium C could be expressed by a relation of the form $pa+qb$, where a and b were definite constants and p and q had integral values 0, 1, 2, 3, &c. This result may be explained by supposing that the β particle initially is liberated within the atom endowed with a certain speed, but that in escaping from the atom it may pass through two or more regions in which the quantity of energy a or b is abstracted. The number of these units of energy abstracted will vary from atom to atom, each individual atom probably giving rise to only a few of the types of β rays observed. Evidence was given that the values a and b served as a measure of the energy of the γ rays emitted from radium, and were connected with the energy of the β particle required to excite the characteristic radiations in the atoms of radium B or C. Prof. Rutherford said that it is of great theoretical importance to examine with the greatest care the nature of the emission of β rays from all the known radio-active substances, for it promises to throw a great deal of light on the interior structure of the atom.

DUBLIN.

Royal Irish Academy, February 12.—Dr. R. F. Scharff, vice-president, in the chair.—Rev. W. J. **Ryan** and T. **Hallissy**: Some new fossils from Bray Head, co. Wicklow. This paper records the discovery, by the authors, of new fossils at Bray Head, co. Wicklow, in the formation known as the Bray and Howth series. As the field-relations of these beds to the adjoining altered shales are obscure, different opinions have been held by geologists as to their stratigraphical position in the geological series, and owing to the absence from the formation of well-recognised type-fossils, it has hitherto been impossible to fix the age of the rocks with any degree of certainty. The importance of the recent discovery lies in the possibility that the new fossils may possess a zonal value such as may finally settle this interesting question. Mr. Cowper Reed, who examined some of the fossils, thinks they suggest the head-shield of a large trilobite like *Solenopleura howleyi* from the Cambrian of Conception Bay, Newfoundland. Other fossils found closely resemble Walcott's holothurians, *Eldonia ludwigi* and *Louisella pedunculata*, from the Middle Cambrian Burgess Shale (Stephen formation), British Columbia. The authors infer that it is highly probable that the green and purple slates of Bray Head in which these fossils have been found must be referred to the same horizon of the Middle Cambrian as the Burgess Shale of British Columbia.—R. A. P. **Rogers**: Some differential properties of the orthogonal trajectories of a congruence of curves. The family of curves defined by $ldx+mdy+ndz=0$ are envelopes of "normal curves," *i.e.* those having l, m, n for normal at each point of space. Dupin's theorem, Darboux's reciprocal theorem, &c., are special cases of two simple relations connecting "normal torsions." The effect of inversion on normal torsion. The indicatrices of torsion and of curvature, and the relation between them. Expression of the condition of integrability as a relation between normal torsions. The indicatrix of form. Expression of the Curl-vector and Divergence by torsion, curvature, and the magnitude and direction of the gradient of the original vector. Second type of generalisations of Dupin's theorem, &c., arising from double generalisation of lines of curvature (Voss's *Krümmungslinien* and *Hauptkrümmungslinien*).—S. B. **Kelleher**: Poisson's equation and the equations of equilibrium of an elastic solid when the surface displacements are given.

BOOKS RECEIVED.

Farmers of Forty Centuries, or Permanent Agriculture in China, Korea, and Japan. By Dr. F. H. King. Pp. ix+441. (Madison, Wis.: Mrs. F. H. King.) 2.50 dollars.

Elements of Physiological Psychology. By Profs. G. T. Ladd and R. S. Woodworth. New edition. Pp. xix+704. (New York: Charles Scribner's Sons.) 4 dollars net.

Kaiserliche Akademie der Wissenschaften. Atlas Typischer Spektren. By Profs. J. M. Eder and E. Valenta. Pp. xv+143+Plates i. to liii. (Wien: A. Hölder.)

Carnegie Institution of Washington. Year Book No. 10, 1911. Pp. xvi+296. (Washington: Carnegie Institution.)

The Methods of Petrographic-Microscopic Research. By F. E. Wright. Pp. 204+plates. (Washington: Carnegie Institution.)

Feeding Experiments with Isolated Food-substances. By T. B. Osborne, L. B. Mendel, and E. L. Ferry. Part ii. Pp. 55–138. (Washington: Carnegie Institution.)

The Absorption Spectra of Solutions of Comparatively Rare Salts. By H. C. Jones and W. W. Strong. Pp. viii+112+plates. (Washington: Carnegie Institution.)

A New Algebra. By S. Barnard and J. M. Child. Vol. ii., containing parts iv.–vi. With Answers. Pp. x+301–731. (London: Macmillan and Co., Ltd.) 4*s*.

An Introduction to British Clays, Shales, and Sands. By A. B. Searle. Pp. xi+451. (London: Charles Griffin and Co., Ltd.) 7*s*. 6*d*. net.

Distribution and Origin of Life in America. By Dr. R. F. Scharff. Pp. xvi+497. (London: Constable and Co., Ltd.) 10s. 6d. net.

Organic Chemistry. By Profs. W. H. Perkin, F.R.S., and F. S. Kipping, F.R.S. Parts i. and ii. complete. New edition. Pp. xi+664+xx. (London and Edinburgh: W. and R. Chambers, Ltd.) 7s. 6d.

Theoretische Mechanik. By Prof. R. Marcolongo. Translated by Prof. H. E. Timerding. Zweiter Band. Dynamik. Pp. vii+344. (Leipzig and Berlin: B. G. Teubner.) 10 marks.

Das Weltproblem. By J. Petzoldt. Zweite Auflage. Pp. xii+210. (Leipzig and Berlin: B. G. Teubner.) 3 marks.

Historical Papers on Modern Explosives. By G. W. MacDonald. Pp. x+192. (London: Whittaker and Co.) 7s. 6d. net.

Zur Kenntnis des negativen Druckes in Flüssigkeiten. By J. Meyer. Pp. iii+53. (Halle: W. Knapp.) 2.10 marks.

The Clarendon Geography. Vol. i. By F. D. Herbertson. Pp. viii+379. (Oxford: Clarendon Press.) 3s.

Evolution in the Past. By H. R. Knipe. Pp. xv+242. (London: Herbert and Daniel.) 12s. 6d. net.

The Ox and its Kindred. By R. Lydekker, F.R.S. Pp. xi+271. (London: Methuen and Co., Ltd.) 6s.

Formal Logic: a Scientific and Social Problem. By Dr. F. C. S. Schiller. Pp. xviii+423. (London: Macmillan and Co., Ltd.) 10s. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 29.

ROYAL SOCIETY, at 4.30.—The Bacterial Production of Acetylmethylcarbinol and 2.3. Butylene Glycol. II: Dr. A. Harden, F.R.S., and Dorothy Norris.—An Instrument for Measuring the Distance between the Centres of Rotation of the Two Eyes: H. S. Ryland and B. T. Lang.—The Locomotor Function of the Lantern in *Echinus*, with remarks on other Allied Lantern Activities: Dr. J. F. Gemmill.—The Relation of Wild Animals to Trypanosomiasis: Capt. A. D. Fraser, R.A.M.C., and Dr. H. L. Duke.—The Transmission of *Trypanosoma nanum* (Laveran): Dr. H. L. Duke.—The Development of a Leucocytozoon of Guinea-pigs: E. H. Ross.

FRIDAY, MARCH 1.

ROYAL INSTITUTION, at 9.—The Total Solar Eclipse in the South Pacific, April, 1911: Dr. W. J. S. Lockyer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Masonry Dams: H. J. F. Gourley.

GEOLOGISTS' ASSOCIATION, at 8.—The Natural History of Petroleum: A. Wade.

SATURDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 4.

SOCIETY OF ENGINEERS, at 7.30.—The Trolley Vehicle System of Railless Traction: H. C. Adams.

ARISTOTELIAN SOCIETY, at 8.—A Theory of Material Fallacies: H. S. Shelton.

AËRONAUTICAL SOCIETY, at 8.30.—Military Airships: Lieut. C. M. Waterlow, R.E.

ROYAL SOCIETY OF ARTS, at 8.—The Loom and Spindle: Past, Present and Future: Luther Hooper.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Photographic Process: Dr. C. E. Kenneth Mees.—Notes on the Estimation of Glucose in Leather: J. Gordon Parker and J. R. Blockey.

TUESDAY, MARCH 5.

ROYAL INSTITUTION, at 3.—Optical Determination of Stress, and some Applications to Engineering Problems: Prof. E. G. Coker.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Tribes of the Central Province of Southern Nigeria: N. W. Thomas.

RÖNTGEN SOCIETY, at 8.15.—Physiological Action of an Alternating Magnetic Field: Prof. S. P. Thompson, F.R.S.—Demonstration of Radiometer: W. Hampson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—(1) Roller and Ball Bearings; (2) The Testing of Anti-friction Bearing Metals: Prof. J. Goodman.

ZOOLOGICAL SOCIETY, at 8.30.—The Classification, Morphology, and Evolution of the Echinoidea Holectypoida: Herbert L. Hawkins.—Blood-Parasites found in the Zoological Gardens during the Four Years 1908–1911: H. G. Plimmer, F.R.S.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1906. Report on some Larval and Young Stages of Prawns from Lake Tanganyika: Dr. G. O. Sars.—On the Structure of the Internal Ear, and the Relation of the Basi-cranial Nerves in *Dicynodon*, and on the Homology of the Mammalian Auditory Ossicles: Dr. R. Broom.

WEDNESDAY, MARCH 6.

SOCIETY OF PUBLIC ANALYSTS, at 8.—A Method of Estimating Calcium Carbonate in Soils: H. S. Shrewsbury.—Standards for Malt Vinegar: A. C. Chapman.—The Estimation of Ammonia in Carbonated Waters: G. D. Elsdon and N. Evers.—A Note on a New Preservative for Milk, Cream, etc.—G. A. Stokes.

ROYAL SOCIETY OF ARTS, at 8.—Some Modern Problems of Illumination: The Measurement and Comparison of Light Sources: T. Thorne Baker.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, MARCH 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* (1) On the Devitrification of Silica Glass; (2) The Volatility of Metals of the Platinum Group: Sir William Crookes, O.M., For. Sec. R.S.—An Optical Load-extension Indicator, together with some Diagrams obtained therewith: Prof. W. E. Dalby.—(1) The Velocity of the Secondary Cathode Particles ejected by the Characteristic Röntgen Rays; (2) The Transmission of Cathode Rays through Matter: R. Whiddington.—On the Voltage Effect in Selenium: E. E. Fournier d'Albe.

LINNEAN SOCIETY, at 8.—Internodes of Calamites: Prof. Percy Groom.—Coloured Drawings of Barbados Plants: Miss Ethel M. Phillips.—On *Psygmophyllum majus*, sp. n., from the Lower Carboniferous Rocks of Newfoundland, together with a Revision of the Genus and Remarks on its Affinities: E. A. Newell Arber.—Historic Doubts about *Vaunthompsonia*: Rev. T. R. R. Stebbing.—Living Specimens of Cactoid Euphorbias from South Africa: Dr. Otto Stapf.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Tariffs for Electrical Energy, with Particular Reference to Domestic Tariffs: W. W. Lackie.

FRIDAY, MARCH 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—The Distribution and Habits of Alcpia, a Subgenus of Clausilia: Rev. A. H. Cooke.—A Synopsis of the Recent and Tertiary Freshwater Mollusca of the Californian Province. Part I. Pelecypoda and Pulmonata: H. Hannibal.—Note on the Existence of Two Editions of Férussac's Tableaux Systématiques: Major M. Conolly. Note on *Pleurotoma bipartita*, Smith: E. A. Smith.

PHYSICAL SOCIETY, at 8.—Exhibition of a "Method of Making Capillary Filaments": H. S. Souttar.—The Intensity at Points near the Principal Focus of an Object Glass with Symmetrical Aberration: J. Walker.—The Equipment of the Spectroscopic Laboratory of the Imperial College of Science: Prof. A. Fowler, F.R.S.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

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